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PROCEDURES FOR PREPARING EMISSIONS PROJECTIONS

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By

E. H. Pechan & Associates, Inc.
Springfield, VA 22151

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EPA Project Officer: Keith Baugues

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ACRONYMS AND ABBREVIATIONS

AFSEF	AIRS Facility Subsystem Emission Factors
AIRS	Aerometric Information Retrieval System
AUSM	Advanced Utility Simulation Model
BEA	Bureau of Economic Analysis
BEIS	Biogenic Emissions Inventory System
BLS	Bureau of Labor Statistics
CAA	Clean Air Act
CAAA	Clean Air Act Amendments of 1990
CARB	California Air Resources Board
CHIEF	Clearinghouse for Inventories and Emission Factors
CMSA	Consolidated Metropolitan Statistical Area
CO	Carbon Monoxide
CTG	Control Technique Guidelines
EPS	Emission Preprocessor System
FMVCP	Federal Motor Vehicle Control Program
GNP	Gross National Product
HPMS	Highway Performance Monitoring System
I/M	Inspection and Maintenance
LNB	Low NO_x Burners
MACT	Maximum Available Control Technology
MPO	Metropolitan Planning Organization
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standard
NAPAP	National Acid Precipitation Assessment Program
NEDS	National Emissions Data Systems
NO_2	Nitrogen Dioxide

NO_x	Oxides of Nitrogen
NSPS	New Source Performance Standard
O_3	Ozone
OAQPS	Office of Air Quality Planning and Standards
QA	Quality Assurance
QC	Quality Control
RACT	Reasonably Available Control Technology
RE	Rule Effectiveness
ROM	Regional Oxidant Model
ROMNET	Regional Oxidant Modeling for Northeast Transport
RP	Rule Penetration
RPC	Regional Planning Commission
RVP	Reid Vapor Pressure
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SCC	Source Classification Code
SIC	Standard Industrial Classification
SIP	State Implementation Plan
SOCMI	Synthetic Organic Chemical Manufacturing Industry
THC	Total Hydrocarbon
TSDF	Treatment Storage and Disposal Facility
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compound

FOREWORD

The purpose of this document is to provide guidance for projecting emissions to future years. It focuses primarily on procedures for projecting how the combination of future emission controls and changes in source activity will influence future air pollution emission rates. While many of the procedures in this document can be applied to other pollutants (i.e., PM-10, SO_2, and toxics), the methods are directed towards ozone precursors and carbon monoxide. Later guidance should more specifically address other pollutants.

Software which incorporates the techniques outlined in this document is expected to be released in the spring of 1992. This will be accomplished by modifying the Emission Preprocessor System to include the effects of growth and controls. In the long term -- over the next three years -- EPA plans to develop a new emission preprocessor (Emissions Preprocessor Analysis Module) which will also simulate growth and control effects.

I INTRODUCTION AND SUMMARY

A. BACKGROUND

As a result of the U.S. Environmental Protection Agency's (EPA) program dealing with the control of atmospheric ozone (O_3) and carbon monoxide (CO), state and local air pollution control agencies responsible for O_3 or CO nonattainment areas must prepare base year emission inventories and project emissions to future years to serve as a basis for State Implementation Plans (SIPs). The purpose of this document is to provide detailed, comprehensive guidance for projecting emissions to future years. It is assumed that readers of this report are familiar with all of the companion EPA documents that describe how to prepare a base year (currently 1990) emission inventory (these are listed in the Bibliography). That material is not repeated here.

The focus of this report is on procedures for projecting how the combination of future emission controls and changes in source activity will influence future air pollution emission rates. While most of the emphasis in this document is on estimating future O_3 precursor emissions, CO emission projection procedures are presented as well.

B. OVERVIEW

The goal in making projections is to try to account for as many of the important variables that affect future year emissions as possible. Each nonattainment area is encouraged to incorporate in its analysis the variables that have historically been shown to affect its economy and emissions the most, as well as the changes that are expected to take place over the next 10 to 20 years.

Each area should examine the source types that currently dominate its inventory and each should perform some rough calculations to see if that source distribution is likely to change much in the near future. This should suggest the emphasis that might be placed on projection methods for predominant source categories (if there are any).

In the typical ozone nonattainment area, there is normally a wide range of ozone-precursor-emitting source types. Thus, it is probably only in exceptional cases where there are only one or two major source types that dominate the inventory. Large point-source emitters in ozone nonattainment areas are already subject to Reasonably Available Control Technology (RACT) requirements and, in some cases, control technique guidelines (CTGs), which may be identical. Therefore, there are likely to be many different volatile organic compound (VOC) emitters in ozone nonattainment areas whose emissions need to be tracked with time. In cases where there are a few dominant sources, special techniques should be used to ensure that those sources are modeled using more sophisticated techniques than those used for the rest of the inventory.

Whether or not an area expects to have any interest in estimating control costs and making selections of measures based on cost effectiveness will influence the choice of projection methods. The area's needs for inputs to a grid-based model are also a factor in making projections.

Cost analyses are best performed using as much source-specific information as possible. Equations used to estimate control costs typically use uncontrolled emissions, stack gas flow rate, and/or unit capacity as independent variables. It is also important to know what controls are already in place and what their control effectiveness level is. Requirements in the Clean Air Act (CAA) Amendments of 1990 (CAAA) for new, more stringent control techniques cannot be completely evaluated unless comparisons can be made at the source level. Whether or not a source will meet RACT or Maximum Available Control Technology (MACT) requirements with existing controls can only be determined at the source level.

Likewise, grid-based models require source locations (coordinates) as input, so a projection approach that makes its computations at this level is preferred. The alternative is to assume that all growth and retirement occurs at existing facilities and that there is no variation in growth or control within each source category.

The organization of the base year inventory and the methods used to make emission projections are also related. As an example, emission inventory source categories and the categories used in the projection analysis should be determined by the regulations likely to be applied. The CTG documents currently being prepared for the source types are listed below.

- Synthetic Organic Chemical Manufacturing Industry (SOCMI) Reactor Processes
- SOCMI Distillation Processes
- Plastic Parts (Business Machines) Coatings
- Plastic Parts Coatings (Other)
- Web Offset Lithography
- Auto Body Refinishing
- Clean-Up Solvents
- Petroleum and Industrial Wastewater
- Wood Furniture Manufacturing
- SOCMI Batch Processes
- Volatile Organic Liquid Storage Tanks

It is important that the VOC emissions for each of these source types be included in the base year emission estimates, and that each of these categories be treated separately in the emission projections. Otherwise, the emission benefit of the new CTGs will be unquantifiable.

There is a need for flexibility in being able to adapt control strategy planning to accommodate changing information. New knowledge about emissions and their control becomes available on an irregular basis that does not always correspond with State Implementation Plan (SIP) schedules. Therefore, states need to be prepared to occasionally update ozone standard attainment analyses to take into account the most recent information.

Choice of a projection technique may also be affected by the number of years between the base year and the projection year. **At a minimum, each nonattainment area has to make a projection to its attainment deadline year in order to be able to demonstrate that it will meet the ambient standard.** Ozone nonattainment dates are 1993 for marginal ozone nonattainment areas, 1996 for moderate, 1999 for serious, 2005 for severe (except for New York and Houston, which have until 2007), and 2010 for extreme. Areas with attainment deadlines after 1996 will also have emission projection requirements to measure progress until attainment.

Emissions projections for CO nonattainment areas must be submitted to EPA by November 1992. Draft ozone precursor emission projections are due at the same time. Final ozone precursor emission projections through 1996 for moderate and above areas must be submitted to EPA by November 1993. Final projections beyond 1996 are due for serious and above areas by November 1994.

C. KEY POINTS IN THE GUIDANCE

This section summarizes the most important points in this guidance document. Basic methods and a structure for performing emission projections are also summarized in Figure I.1.

- EPA assumes that, at a minimum, state and local agencies will have available detailed projections of population and employment that can be used to estimate future activity levels.

- For the purpose of base year and projection year emission inventories under the CAAA, EPA will allow the use of an 80 percent default value for rule effectiveness, but will also give states the option to derive local category-specific RE factors.

- Any emission projection made for use in SIP modeling shall use an allowable emission rate for that purpose.

- For the purposes of preparing industrial emission projections for a SIP, it is expected that, at a minimum, earnings projections will be used. Real earnings data are

Figure I.1
Projection Approach Summary

	Point Sources	Stationary Area Sources	Highway Vehicles	Off-Road Vehicles
Activity Level	BEA Earnings Projections; Survey Approach	Table III.3 Indicators; BEA Earnings Projections	Travel Demand Model; Trend Analysis	Table III.3 Indicators; BEA Earnings Projections
Emission Rates	CTG; non-CTG RACT; NSPS; Title III MACT; Title IV for NOx	Emissions Reductions will be related to commercial/consumer solvent regulations and whether areas extend rules to apply to smaller-sized sources as well as what can be achieved by current rules.	MOBILE5 or EMFAC7E	Future rates depend on EPA regulatory decisions.

available for all states at the 2-digit SIC level from the Bureau of Economic Analysis. Data on value added or projected product outputs should be used where available.

- It is recommended that point source survey approaches be used only when there is a dominant industry in an area whose emission growth is not likely to be captured in regional projections, and where there is a reasonable expectation that significant growth may occur.

- Area source projections can be made using local studies or surveys, or through surrogate growth indicators.

- Motor vehicle emission projections are to be made using motor vehicle emission factor models and estimates of future activity (vehicle miles traveled). For states and U. S. territories other than California, MOBILE5 will be the preferred tool for estimating motor vehicle emission rates for years after 1990. MOBILE5 is not scheduled for release until May 1992. In the interim, EPA is planning revisions to MOBILE4.1 to allow states to make CO projections.

- The preferred method for performing VMT projections is to use a validated zonal-based travel demand model. For areas that do not have a validated travel demand model, VMT projections may be based on VMT trends from 1985 to 1990 as measured by the Federal Highway Administration's Highway Performance Monitoring System.

- As highway vehicle emission rates are further reduced, other mobile sources such as aircraft, railroad locomotive diesel engines, vessels, and non-road engines become a more significant portion of the emission inventory. EPA is currently evaluating regulatory initiatives for all of these source types, so emission projections need to be made using the latest available information on likely regulations for these sources (most of which was not available in time to be included in this document).

- Base case emission projections for any area should, at a minimum, include an estimate of the effects of current regulations and standards, plus the likely effect of controls **mandated** by the CAAA. Chapter IV of this report provides guidance on measuring the effects of current and future controls.

- EPA is in the process of upgrading the Emission Preprocessor System (EPS) to provide a computerized tool to implement the guidance in this document. The revised program is expected to be available for distribution to the states by May 1992. Longer term, EPA plans to develop a new emissions preprocessor, the Emissions Preprocessor Analysis Module (EPAM).

- Guidance addressing the issue of performing emission projections for tracking Reasonable Further Progress (RFP) will be published separately. This RFP tracking document is scheduled for publication in November 1991.

D. REPORT ORGANIZATION

Chapter II of this report describes the different types of projections that might be required of a state or local air pollution control agency. Rule effectiveness, rule penetration, and use of actual versus allowable emissions in projections are also discussed in Chapter II.

The two most important steps in performing any emission projection are: (1) estimating future source activity levels and (2) quantifying the effects of current and future controls. These two topics are discussed in separate chapters. Methods for projecting changes in future air pollution generating activities are described in Chapter III. Techniques for quantifying the effects of current and future controls are described in Chapter IV. Chapter IV necessarily focuses on the new control initiatives mandated by the CAAA.

Chapter V describes some options for combining the effects of growth and control in a manner that meets the needs for attainment planning and providing model inputs. Validation of emission projections, primarily by comparing them with other recently completed studies, is discussed in Chapter VI.

It is useful to examine the techniques that have been applied in ozone nonattainment areas where some control strategy planning has already been performed. Chapter VII provides two such examples. The South Coast Air Quality Management District (SCAQMD) has performed such analyses and has prepared future year emission projections in a form suitable for input to a grid-based photochemical model. In the simplest sense, this approach relied on developing a growth factor and a control factor for each major source category. These growth and control factors were then applied universally within the air basin.

The Regional Oxidant Modeling for Northeast Transport (ROMNET) study is another recent example where future year control scenarios were evaluated. It provides examples of preparing grid-based modeling inputs as well.

Biogenic emission projections are discussed in Chapter VIII. In most cases, it is expected that biogenic emissions will be the same in the projection year as they are in the base year. Quality assurance procedures for projections are described in Chapter IX. Requirements for documenting projection methods and future year emission estimates are the subject of Chapter X.

Appendix A lists projected electric generating unit additions by state, company, and plant, from 1990 to 1999. Appendix B is a quality assurance checklist.

The use of historical earnings data to adjust 1990 emission values to match with observed ozone episodes in other years is described in Appendix C.

II TYPES OF PROJECTIONS

This chapter introduces some basic concepts in making emission projections, such as the difference between baseline and control strategy projections. The emphasis of this guidance document is on developing future year emission estimates in a form suitable for use in SIP modeling demonstrations. Thus, while a baseline emissions projection is useful in establishing a starting point for examining the effects of various control scenarios, it is expected that most of the analytical effort will be put in developing several control strategy projections to simulate how the CO or ozone standard might be attained. Rule effectiveness and rule penetration are important concepts to understand before developing an emission projection methodology. They are defined in this chapter. Finally, the need to make emission projections using estimates of allowable emissions is explained.

A. BASELINE EMISSIONS PROJECTIONS

Baseline emissions projections are estimates of future year emissions from point, area, and mobile sources that take into account expected growth in an area, existing air pollution control regulations in effect at the time the projections are made, and regulations expected to take effect at future intervals. Baseline projections are needed by an agency to measure reasonable further progress and to determine additional emissions reductions necessary to attain the National Ambient Air Quality Standards (NAAQS). Baseline emissions projections represent the "typical" situation.

Recommendations for making projections are outlined briefly below. More specific guidance is presented in the chapters that follow.

- To a large extent, projection inventories are based on forecasts of industrial growth, population growth, changes in land use patterns, and transportation growth. The air pollution control agency should not attempt to make independent forecasts, but should rely on the local metropolitan planning organization (MPO), regional planning commission (RPC), or other planning agency to supply them. This course has several advantages. First, development of forecasts is costly and time consuming and would be a duplication of effort. Second, the air pollution control agency should base its emissions projections on the same forecasts used by other governmental planning agencies. This consistency is needed to establish the credibility of any proposed control programs based on emissions projections. However, the air pollution control agency should keep in mind any potential biases which may be inherent in the forecast data supplied by other agencies. Comparison with regional forecasts such as those produced by the Bureau of Economic Analysis (BEA) can assist in finding these potential biases. EPA assumes that, at a minimum, state and local agencies will have available detailed projections of population and employment that can be used to estimate future activity levels.

- All emissions projected for future years should be based on the same inventory methodologies and computational principles as the base year emissions. For example, if a travel demand model is used for estimating travel in the base year, the same model should be applied to estimate travel demand for projection years. Using the same methodology ensures consistency in format and content between base year and projection year emissions estimates and prevents possibly spurious inventory differences due to changes in methodology.

- Projection inventories are open to question because of their speculative nature. The technical credibility of emissions projections is a function of their reasonableness, the amount of research on and documentation of assumptions, and the procedures or methodologies used to make the projections. Some degree of uncertainty will always accompany emissions projections; this should be acknowledged openly and addressed to the extent possible. The art of projecting emissions is not in eliminating uncertainty, but in minimizing it. Internal and external reviews of emissions projections will improve their technical quality and enhance their credibility.

B. CONTROL STRATEGY PROJECTIONS

Control strategy projections are estimates of future year emissions that also include the expected impact of modified or additional control regulations. Past projection efforts may not be very helpful to an air pollution control agency because they often do not reflect all of the growth and control scenarios that the agency may wish to evaluate.

Planners should determine if any future scheduled regulations apply to sources in the nonattainment area or the modeling domain. For example, if an agency is currently developing regulations to control VOC emissions from bakeries, with promulgation scheduled for 1992, any projections for 1993 and beyond would need to take these regulations into account. Likewise, new CAA requirements should also be taken into account when developing projection inventories. These specific requirements will be discussed in Chapter IV of this report.

In addition, state and local agencies should consider the requirements of all Titles in the CAAA, not just Titles I and II. For example, vapor degreasers use solvents which are considered hazardous under Title III. These facilities would be required to achieve MACT standards. Therefore, MACT must be considered in projecting emissions from categories emitting the hazardous air pollutants listed in Title III.

The effects of controls on area sources can usually be simulated by changes in either emission factors or activity levels, depending on the source and nature of the control measure(s) being considered.

C. RULE EFFECTIVENESS AND RULE PENETRATION

Past inventories have assumed that regulatory programs would be implemented with full effectiveness, achieving all of the required or intended emissions reductions and maintaining that level over time. Unfortunately, experience has shown regulatory programs to be less than 100 percent effective in most source categories in most areas of the country. The concept of applying rule effectiveness (RE) has evolved from this observation. In short, RE reflects the ability of a regulatory program to achieve all the emissions reductions that could be achieved by full compliance with the applicable regulations at all sources at all times.

Several factors should be taken into account when estimating the effectiveness of a regulatory program. These include the following: (1) the nature of the regulation (i.e., whether any ambiguities or deficiencies exist, whether record keeping requirements are prescribed); (2) the nature of the compliance procedures (i.e., taking into account the long-term performance capabilities of the control); (3) the performance of the source in maintaining compliance over time (e.g., training programs, maintenance schedules, record keeping practices); and (4) the performance of the implementing agency in assuring compliance (e.g., training programs, inspection schedules, follow-up procedures).

For the purpose of base year and projection year emission inventories under the CAAA, EPA will allow the use of an 80 percent default value for rule effectiveness, but will also give states the option to derive local category-specific RE factors according to guidance contained in <u>Procedures For Estimating And Applying Rule Effectiveness In Post-1987 Base Year Inventories For Ozone And Carbon Monoxide State Implementation Plans</u> (U.S. EPA, 1989).

In both baseline and control strategy projections, the RE determined for the source category should be applied to all sources in the category (both point and area sources) with the following exceptions: (1) sources not subject to the regulation; (2) sources achieving compliance by means of an irreversible process change that completely eliminates emissions; (3) sources for which emissions are directly determined by calculating solvent use over some time period, assuming all solvent was emitted from the source during that time period; and (4) those with measured emissions (continuous emission monitors).

The RE factor shall be applied to the estimated control efficiency in the calculation of emissions from a source. An example of the application is given below.

Uncontrolled emissions = 50 lbs/day
Estimated control efficiency = 90%
Rule effectiveness = 80%
Emissions after control = 50 [1 - (0.90)(0.80)]
= 14 lbs/day

(The application of RE results in a total emissions reduction of 72 percent, not 90 percent)

In addition to RE, rule penetration (RP) is another important regulatory consideration, which is the extent to which a regulation may cover emissions from a source category. When projecting estimated emissions using area source methodologies for source categories where a rule or regulation applies, agencies should incorporate an estimate of the amount of rule penetration by means of the following formula:

$$\text{Rule Penetration} = \frac{\text{Uncontrolled emissions covered by the regulation}}{\text{Total uncontrolled emissions}} \times 100\%$$

Once uncontrolled emissions and rule penetration are determined, RE should be applied as discussed above. An example category follows:

Uncontrolled emissions = 1,000 tpy
Control efficiency required by the regulation = 95%
Rule penetration = 60%
Rule effectiveness = 80%
Emissions from the category =

(1,000)[1 - (0.60)(0.95)(0.80)] = 544 tpy

Further discussions of the use of rule effectiveness and rule penetration are included in <u>Procedures For The Preparation Of Emission Inventories For Carbon Monoxide And Precursors Of Ozone, Volume I</u> (U.S. EPA, 1991).

D. ACTUAL AND ALLOWABLE EMISSIONS

In projecting emissions, states must clearly identify when the projections use actual and when they use allowable emissions. **Actual emissions** are defined as the product of an actual emissions rate for a current year (based on known physical characteristics), the actual operating capacity ("throughput"), and the actual operating schedule of the facility. **Allowable emissions are the product of an enforceable emissions rate (e.g., pounds of VOC per gallon of solids applied), the anticipated operating rate or activity level (e.g., gallons of solids applied** per hour), and the anticipated operating schedule (hours per day).

Any emission projection made for use in SIP modeling shall use an allowable emission rate for that purpose. There are instances, such as RFP modeling, where actual emission rates might be used, but these will be the exception, not the rule. Methods used to estimate future activity levels are not affected by the choice between actual and allowable emission rates. Thus, **allowable emissions are <u>not</u> based on the <u>maximum</u> worst case condition, with the plant operating at full load** (8760 hrs/yr), but are calculated by multiplying the **anticipated** operating rate by the **maximum** allowable emission rate. For example, if a unit with a low NO_x burner is emitting 0.3 lb $NO_x/10^6$ Btu, but the allowable emission rate is 0.4 lb $NO_x/10^6$ Btu, the 0.4 rate would apply in the future case, unless the control strategy changed the applicable regulation.

Consider the case:

1990 Emission Inventory (E.I.)
[The assumed source test measured emissions are 0.3 lb $NO_x/10^6$ Btu.]

[3 x 10^{12} Btu/yr] [0.3 lb $NO_x/10^6$ Btu] = 9 x 10^5 lb NO_x/yr
= Actual Base Year Emissions

1996 Baseline
[Assume a 6 percent growth rate over period, and control only to required level.]

[3 x 10^{12} Btu/yr] [1.06 growth rate] [0.4 lb $NO_x/10^6$ Btu] =
1.3 x 10^6 lb NO_x/yr = Projected Allowable Emissions

1996 Control Strategy Projection
[Assume a new NO_x limit of 0.2 lb $NO_x/10^6$ Btu.]

[3 x 10^6 Btu/yr] [1.06 growth rate] [0.2 lb $NO_x/10^6$ Btu] =
6.4 x 10^5 lb NO_x/yr = Projected Control Strategy Emissions

It should also be understood that there can be a difference between allowable emissions and projected allowable emissions. The distinction is that current activity levels and projected activity levels can be different.

III PROJECTIONS OF FUTURE ACTIVITY

This chapter presents information on procedures that can be used by states to estimate future activity levels, including those that will generate pollution. These procedures range from surveys of individual facility expansion plans to use of national data bases. At the start of the chapter, some general guidelines for choosing among activity indicators are presented. This is followed by a description of EPA's preferred data source for performing projections of future activity for most stationary source categories, the "Bureau of Economic Analysis Regional Projections to 2040" (BEA, 1990a; 1990b; 1990c). **[These data are available from the EPA-OAQPS Emission Inventory Branch in machine-readable form via the CHIEF Bulletin Board System.]** Specific guidance for point, area, and mobile source categories is then presented.

A. GENERAL GROWTH INDICATORS

EPA encourages areas to use the best possible growth indicators appropriate for the region and source category of interest. For those unfamiliar with developing or applying growth indicators, general rules of thumb for choosing among indicators can be applied. Typical indicators (listed in priority order) are provided below:

- Product Output
- Value Added
- Earnings
- Employment

(The effectiveness of each of these four growth indicators will be discussed below.)

Because the major forces behind growth in the economy include the quality and availability of natural resources, capital growth, skill of the labor force, and technological change, the most accurate growth indicator would best encompass these factors. Economic growth involves an increase over time in the actual output of goods and services, as well as an increase in the economy's capability of providing these goods and services.

1. Employment

Theoretically, as employment increases, production will presumably increase until diminishing returns begin to have an affect on markets, and therefore, on production. The **employment** level is a direct measure of growth, only if the stock of natural resources and capital, as well as the level of technology are held constant. Technological change has its impact primarily on the efficiency with which factors of production are used.

Employment data would be a more accurate growth indicator than population data, since higher levels of employment reflect economic growth and, more specifically, reflect rises in pollution-generating activity levels. However, employment figures alone would not be convenient measures of the efficiency with which labor is being used in production. If technological improvement occurs, more output can be produced with the same quantity of labor, holding all other factors constant; employment, for instance, could feasibly remain constant, while the real gross national product (GNP) increases as a result of technological improvements. The employment level alone is therefore not an effective growth indicator in most cases.

2. Earnings

A measure of earnings, rather than employment data, would better reflect the efficiency with which labor has been used in production. Real **earnings** data are thus preferred to employment figures for an industry, because earnings data capture productivity improvements that are not apparent from employment trends. As an example of the difference between using earnings and employment as the basis for projections, the BEA earnings projections for the Texas chemical industry show an expected increase in earnings of $3.16 billion to $3.65 billion from 1988 to 2000 -- an increase of 15.5 percent over that period. Employment for this industry/state combination, on the other hand, is only expected to increase by 2.7 percent over this time period.

3. Value Added

Similarly, value added would be a more accurate growth indicator for industry because it captures factor substitution. By definition, **value added** is a measure of factor costs incurred during production. Consider the following example (Branson, 1972): The manufacture of a $12,500 car requires $11,000 worth of steel, which in turn requires $2,500 of coal and $7,500 of iron to manufacture. The mines sell $10,000 worth of output to the steel firm, which adds $1,000 in capital and labor costs to produce $11,000 of steel. The auto manufacturer adds another $1,000 to make an auto for $12,000, and the dealer adds $500 in services to sell at $12,500 to the customer. (In this example, each producer adds value to the final product.) Total value added is $10,000 by the mines, $1,000 each by the steel and auto manufacturers, and $500 by the dealer, for a total cost of $12,500. The price of the final output reflects the value of each input, or the total value added.

Consider the steel firm that bought $10,000 of output from the mines. The $1,000 of capital and labor costs that were added also represent the firm's income after selling $11,000 of steel to the auto manufacturer. This $1,000 income figure is then used to pay the firm's factors of production. For each firm in this example, the sum of the value added equals the firm's income.

Hence, value added is defined as the value of a product sold by a firm less the value of the goods purchased and used by the firm to produce the product, and equal to the revenue which can be used for wages, rent, interest, and profits. The sum of each firm's income in this simple example equals $12,500 ($10,000 for mines, $1,000 for steel firm, etc.), which is also equal to total value added and is reflected on the income side of GNP. The national income figure in total GNP is both a measure of production and a measure of money income. It represents the factor costs of current output and the money earned by the factors of production. Used as a growth indicator, value added would therefore encompass substitution among factors of production, and would indirectly reflect technological change. Data representing total value added ($2,500 in this case) are reflected in the national income figure of GNP, since the sum of all incomes (wages, interest, rent, and profit) is equal to the total value added and, therefore, to the total (final) product.

The periodic Census of Manufactures is a source of published data on value added. This survey is performed by the U.S. Department of Commerce, Bureau of the Census.

4. Product Output

Finally, the most direct indicator of future emissions activity is **product output**. All four of the factors mentioned above, employment, resource availability, capital growth, and technology, are directly related to product output level. Output is a good indicator of the prevailing employment situation, as well as of the resources and capital available to producers. The actual output level is determined by the efficiency with which these resources are being used, which is in turn a reflection of technological change. Population changes should also be taken into account when using product output totals, since product output per capita is the most meaningful growth indicator. Any regional projections of future product would thus be preferable to any of the above indicators, if it is available.

For the purposes of preparing industrial emission projections for a State Implementation Plan, it is expected that, at a minimum, earnings projections would be used. Real earnings data are available for all states at the two-digit Standard Industrial Classification (SIC) level from the BEA. Data on value added or projected product outputs should be used where available.

B. REGIONAL PROJECTIONS USING BEA DATA

As stated at the beginning of this chapter, the U.S. Department of Commerce's BEA data on Regional Projections to 2040 provide a useful set of regional growth data that EPA recommends for use in preparing emission projections. The first volume (BEA, 1990a) presents projections to the year 2040 of economic activity and population for the nation and the states. The second and third volumes (BEA, 1990b; 1990c) present projections for metropolitan statistical areas (MSAs) and BEA economic areas, respectively. Table III.1 shows the level of detail of reporting for states and how it differs from that available for MSAs and BEA Economic Areas. Projections are presented for population in three age groups, by personal income (classified by major income component), and by employment and earnings, each of which is presented for 57 industrial groups. Projections are available for 1995, 2000, 2005, 2010, 2020, and 2040; historical data are available for 1973, 1979, 1983, and 1988. BEA data are available in either report or machine-readable form. [Hard copy reports are for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.]

A new set of BEA regional projections is published every five years. The projections assume the continuance of past economic relationships and assume no major policy changes. They are neither goals for, nor limits on, future economic activity in any region or state. Further, they are not an assessment of the probable success or failure of any regional development program established by or proposed for a state.

The methods used by the BEA to prepare their projections are informative and are therefore summarized below. A more detailed treatment of the same information can be found in the BEA published reports. The BEA projections were made in two major steps: first for the nation and then for the states. In the first major step, national long-term projections were developed for 1995, 2000, 2005, 2010, 2020, and 2040. (The short-term projections are of most interest in preparing SIP emission projections.) GNP was projected based on projections of population, labor force, employment, and GNP per employee. The population projections were based mainly on the work of the U.S. Census Bureau, and the labor force projections were based mainly on the work of the Bureau of Labor Statistics (BLS). The GNP projections, for the most part, were the basis for the derivation of other national measures, including total personal income by component and both employment and earnings by industry. For 1995, alternative national projections of total personal income by component, and of both employment and earnings by industry were derived by totaling 1995 econometric projections for the states. These sum-of-state econometric projections then were used as part of the review process to determine the long-term national projections for 1995.

In the second major step, state projections of employment and earnings by industry, population, and total personal income by component were made within the framework of the corresponding projected national totals. First, long-term state projections for 1995, 2000, 2005, and 2010 were made, based on historical economic relationships within each state between basic industries (those that mainly serve national markets) and service industries (those that mainly serve local markets). In some cases, the

Table III.1

Industrial Groupings for the BEA Regional Projections

Industries projected for MSA's and BEA economic areas	Industries projected for States and the Nation	1972 SIC code
Farm	Farm	01,02
Agricultural services, forestry, fisheries, and other	Agricultural services, forestry, fisheries, and other[1]	07,08,09
Mining	Mining	
	Coal mining	11,12
	Oil and gas extraction	13
	Metal mining	10
	Nonmetallic minerals, except fuels	14
Construction	Construction	15,16,17
Manufacturing	Manufacturing	
Nondurable goods	Nondurable goods	
	Food and kindred products	20
	Tobacco manufactures	21
	Textile mill products	22
	Apparel and other textile products	23
	Paper and allied products	26
	Printing and publishing	27
	Chemicals and allied products	28
	Petroleum and coal products	29
	Rubber and miscellaneous plastic products	30
	Leather and leather products	31
Durable goods	Durable goods	
	Lumber and wood products	24
	Furniture and fixtures	25
	Stone, clay, and glass products	32
	Primary metal industries	33
	Fabricated metal products	34
	Machinery, except electrical	35
	Electric and electronic equipment	36

[1]"Other" refers to U. S. residents employed by international organizations and foreign embassies and consulates located in the United States.

Table III.1 continued

Industrial Groupings for the BEA Regional Projections

Industries projected for MSA's and BEA economic areas	Industries projected for States and the Nation	1972 SIC code
	Transportation equipment, excluding motor vehicles	37 except 371
	Motor vehicles and equipment	371
	Instruments and related products	38
	Miscellaneous manufacturing industries	39
Transportation and public utilities	Transportation and public utilities	
	Railroad transportation	40
	Trucking and warehousing	42
	Local and interurban passenger transit	41
	Transportation by air	45
	Pipelines, except natural gas	46
	Transportation services	47
	Water transportation	44
	Communication	48
	Electric, gas, and sanitary services	49
Wholesale trade	Wholesale trade	50,51
Retail trade	Retail trade	52-59
Finance, insurance, and real estate	Finance, insurance, and real estate	
	Banking and credit agencies	60,61
	Holding companies and investment services	62,67
	Insurance	63,64
	Real estate	65,66
Services	Services	
	Hotels and other lodging places	70
	Personal services	72
	Business and miscellaneous repair services	73,76
	Auto repair, services, and garages	75
	Amusement and recreation services and motion pictures	78,79
	Private households	88
	Health services	80
	Legal services	81

Table III.1 continued

Industrial Groupings for the BEA Regional Projections

Industries projected for MSA's and BEA economic areas	Industries projected for States and the Nation	1972 SIC code
	Educational services	82
	Social services and membership organizations	83,86
	Miscellaneous professional services	84,89
Government and government enterprises	Government and government enterprises	
Federal, civilian	Federal, civilian	
Federal, military	Federal, military	
State and local	State and local	

long-term state projections to 2010 were modified to be consistent with the state economic projections for 1995.

In each state, employment in each industry was projected according to one of two sets of criteria, depending on whether the industry was classified as basic or service. **Basic** industries are those that make products that are generally exportable out of a state. Because of the potentially broad market for such products, it was assumed that each state competes for a share of the national market of each basic industry. Accordingly, employment in each basic industry in each state was projected on the basis of the historical trend of the state's share of employment in that industry on a national level. The projections of basic-industry employment reflected the assumption that the factors affecting a state's employment share in the past (for example, relative wage rates, access to inputs and markets) will continue to affect it in the future, but less strongly, so that in all cases the rate of change in employment share slows. Thus, each state's share of each basic industry was assumed to change at a decelerating rate toward a long-term equilibrium.

Service industries are those that make products that, in general, satisfy only local demand. It was assumed that, in each state, employment in each service industry is determined by the level of local demand, which, in turn, depends on the overall size of the economic base. Thus, in each state, service industry employment was determined by the share of the national market accounted for by the state's basic industries. Projections of employment in each service industry were tied to basic-industry employment by means of the service industry location quotient, that is, the ratio of a service industry's share of total employment in a given state to that industry's share of total national employment.

Projections of service industry employment location quotients were based on historical trends for each industry. In most cases, the result was convergence toward unity; convergence is consistent with the assumption that, in the long term, the service components of state economies will become similar to one another. In cases where a location quotient was diverging from unity over time, the historical trend generally was damped or reversed in the projection period.

It was necessary to categorize each of the 57 industries for which projections were prepared as either basic or service industries. While basic industries are primarily dependent on national demand, and service industries on local demand, it is important to point out that each basic industry in a state is impacted by, and has an impact on, other industries in the state. Thus, basic industries are seldom oriented exclusively toward the national economy. Similarly, service industries do not necessarily provide to only local residents and businesses. In short, a local element exists in most basic industries, and a potential (if not actual) export element exists in most service industries. Because it was not feasible to classify each industry as part-basic and part-service, a state-specific basic/service dichotomy of the 57 industries was made. This dichotomy is shown in Table III.2.

Long-term projections to 2010 of state earnings by industry were made in three steps. First, the historical trend in state earnings per employee in an industry was extended as a percentage of national earnings per employee in the corresponding industry. Second, this measure was multiplied by national earnings per employee in the industry. Third, this product was multiplied by projected state employment in the industry to yield projected state earnings in the industry.

C. POINT SOURCES

One approach for projecting emissions from major point sources, other than using BEA factors (see previous section), is to obtain information on an individual facility basis. This type of projection information can be obtained directly through contacts with plant personnel and through the use of survey questionnaires. Questionnaires can be sent out solely to solicit projection plans, or can be integrated into the periodic update procedures employed to update the emission inventory to 1990 or the permits system. In most situations, however, this information will not be available for every point source, so other methods must be employed.

For some large point sources, projection information may be available for most, but not all, sources within the given category. For example, 10 paint manufacturing plants may operate in the area of interest, but successful contacts have been made with only 8 plants. A reasonable approach would be to evaluate the growth trends for the eight plants and apply the resulting average growth trend to the other two plants.

For smaller point sources, obtaining projection information for each plant may not be feasible (or desirable). In these cases, the rate of activity growth is best estimated via a surrogate activity indicator.

Before plans are adopted for extensive surveying of local facilities, areas should be aware that reliance on industry-(plant) specific forecasts has some pitfalls. Sources do not want to give their competitors information on projected activities, and will not include future expansion plans until the proper feasibility studies have been performed. **Therefore, EPA recommends that point source survey approaches be used only when there is a dominant industry in an area whose emission growth is not likely to be captured in regional projections, and where there is a reasonable expectation that significant growth or decline may occur.**

Table III.2

BEA Regional Projections

Basic/Service Classification of Industries

Industry	Classification
Farm	Always Basic
Agricultural Services, Forestry, Fisheries, and other	Always Basic
Mining:	
Coal Mining	Always Basic
Oil and Gas Extraction	"
Metal Mining	"
Nonmetallic Minerals, except Fuels	*
Construction	Always Service
Manufacturing	
Nondurable Goods	
Food and Kindred Products	*
Textile Mill Products	Always Basic
Apparel and Other Textile Products	"
Paper and Allied Products	"
Printing and Publishing	*
Chemicals and Allied Products	Always Basic
Petroleum and Coal Products	
Tobacco Manufactures	
Rubber and Miscellaneous Plastic Products	
Leather and Leather Products	
Durable Goods	
Lumber and Wood Products	Always Basic
Furniture and Fixtures	"
Primary Metal Industries	"
Fabricated Metal Products	"
Machinery, Except Electrical	"
Electric and Electronic Equipment	"
Transportation Equipment, excluding Motor Vehicles	"
Motor Vehicles and Equipment	"
Stone, Clay, and Glass Products	"
Instruments and Related Products	"
Miscellaneous Manufacturing Industries	"

* Basic only if location quotient exceeds a threshold value.

Table III.2 (continued)

Transportation and Public Utilities	
Railroad Transportation	Always Basic
Trucking and Warehousing	*
Water Transportation	Always Basic
Local and Interurban Passenger Transit Air Transportation	*
Pipelines, except Natural Gas	Always Basic
Transportation Services Communication Electric, Gas, and Sanitary Services	*
Wholesale Trade	*
Retail Trade	*
Finance, Insurance, and Real Estate	
Banking and Credit Agencies Holding Companies and Investment Services Insurance Real Estate	*
Services	
Hotels and other Lodging Places Personal Services	*
Private Households	Always Service
Business and miscellaneous Repair Services Auto Repair, Services, and Garages Amusements, Recreation Services, and Movie Theaters Health Services Legal Services Educational Services Social Services and Membership Organizations Miscellaneous Professional Services	*
Government and Government Enterprises	
Federal, Civilian	*
Federal, Military	Always Basic
State and Local	Always Service

* Basic only if location quotient exceeds a threshold value.

It is expected that base year emission inventory point source records to be used in emission projections will include SIC codes for each plant or process. This is important, because almost any activity growth indicators will be on an industrial category (SIC) basis. Published lists of Aerometric Information Retrieval System (AIRS) Facility Subsystem Source Classification Codes (SCCs) are organized by SIC code in order to facilitate the determination of the applicable SIC once the SCC is known (EPA, 1990a). Therefore, no default SCC-SIC matches are provided for point sources in this report, but are available in AFSEF.

D. AREA SOURCES

As with point sources, area source projections can be made using local studies or surveys or through surrogate growth indicators, such as BEA, to approximate the rise or fall in expected activity. The most commonly used surrogate growth indicators are those parameters typically projected by local MPOs such as population, housing, land use, and employment. Regardless of the growth indicator employed, the calculation is the same: the ratio of the value of the growth indicator in the projection year to its value in the base year is multiplied by the area source activity level in the base year to yield the projection year activity level.

A major difference between making area source projections for the basic, county-wide inventory and for the detailed, photochemical inventory is that, in the latter, emission estimates must be resolved at the grid-cell level. This adds a dimension of complexity to the projection effort, as changing growth patterns may require that different apportioning factors be determined for the projection years. Fortunately, in most large urban areas where photochemical models are employed, the local MPO will be able to provide land use maps, as well as detailed zonal projections of employment, population, etc., for future years. Hence, these projections can be used directly, as described above, to determine changes in spatial emission patterns.

If the surrogate indicators used for apportioning certain area source emissions are not projected at a subcounty level, engineering judgment must be used to decide whether spatial distributions of various activities will change enough to warrant the effort of identifying new patterns. Changes may be warranted in rapidly growing areas for the more important area source emitters. For regions where little growth is expected, and especially for minor area sources, the same apportioning factors can be used in baseline and projection inventories.

Table III.3 summarizes preferred growth indicators for each major area source category. Potential information sources are also noted on the table.

Table III.3

Growth Indicators For Projecting Emissions For Area Source Categories

Source Category	Growth Indicators	Information Sources
Gasoline Marketing	projected gasoline consumption	MOBILE4 fuel consumption model
Dry Cleaning	population; retail service employment	solvent suppliers; trade associations
Degreasing (Cold Cleaning)	industrial employment	trade associations
Architectural Surface Coating	population or residential dwelling units	local MPO
Automobile Refinishing	industrial employment	BEA
Small Industrial Surface Coating	industrial employment	BEA
Graphic Arts	population	state planning agencies; local MPO
Asphalt Use - Paving	consult industry	consult industry
Asphalt Use - Roofing	industrial employment; construction employment	local industry representatives
Pesticide applications	historical trends in agricultural operations	state department of agriculture; local MPO
Commercial/Consumer Solvent Use	population	local MPO; state planning agencies
Publicly Owned Treatment Works (POTWs)	site-specific information	state planning agencies
Hazardous Waste Treatment, Storage and Disposal Facilities (TSDFs)	state planning forecasts	state planning agencies; local MPO;
Municipal Solid Waste Landfills	state waste disposal plan	local MPO; state planning agencies
Residential Fuel Combustion	residential housing units or population	local MPO
Commercial/ Institutional Fuel Combustion	commercial/ institutional employment; population	local MPO; land use map projections
Industrial Fuel Combustion	industrial employment (SIC 10-14, 50-51); or industrial land use	local MPO; land use projections; state planning agencies
Aircraft (Commercial and General)	site-specific forecasts	local airport authority and commercial carriers
Aircraft, Military	site-specific forecasts	local airport authorities; appropriate military agencies
Railroads	revenue ton-miles	American Association of Railroads and local carriers
Ocean-going and River Cargo Vessels	cargo tonnage	local port authorities; U.S. Maritime Administration; U.S. Army Corps of Engineers
Vessels, small pleasure craft	population	local MPO
Off-Highway Motorcycles	population	local MPO
Agricultural Equipment	agricultural land use; agricultural employment	local MPO; Census of Agriculture
Construction Equipment	industry growth (SIC Code 16)	local MPO
Industrial equipment	Industrial employment (SIC codes 10-14, 20-39, 50-51) or industrial land use area	local MPO

Table III.3 (continued)

Source Category	Growth Indicators	Information Sources
Lawn and Garden Equipment	single-unit housing	local MPO
On-site Incineration	based on information gathered from local regulatory agencies	local regulating agencies and MPO; state planning agencies
Open Burning	based on information gathered from local regulatory agencies	local agencies; state planning agencies; local MPO
Fires: Managed Burning, Agricultural Field Burning, Frost Control (Orchard Heaters)	areas where these activities occur	U.S. Forest Service, state agricultural extension office
Forest Wildfires	historical average	local, state, and federal forest management officials
Structural Fires	population	local MPO; state planning agencies

E. MOBILE SOURCES

1. Highway Vehicles

a. Travel Demand Forecasting

Information on techniques that are acceptable to EPA for estimating future changes in highway vehicle activity can be found in a number of recent or planned EPA publications. These include the Sec. 187 vehicle miles traveled (VMT) guidance, the General Preamble for Title I of the CAAA, which is scheduled to be published in the fall of 1991, and Sec. 108 transportation control measure effectiveness information documents. In addition, by November 1991, areas can expect further EPA guidance for projecting VMT in areas where projections are needed (i.e., ozone nonattainment areas that may be required to perform more sophisticated analyses than the situations covered by the Sec. 187 VMT guidance).

The preferred method for performing VMT projections is to use a validated zonal-based travel demand model. Such a model is required by EPA guidance when making projections beyond 1996.

Areas using a validated zonal-based network travel demand model to forecast VMT growth must validate those models against 1985 or more recent ground traffic counts. Validation using 1990 traffic counts is preferred.

Since travel demand model output will not be available for some of the required forecasting years, each nonattainment area may linearly interpolate between chronological travel demand model estimation years to estimate growth factors between 1990 and any applicable projection years, where necessary.

Any nonattainment area planning to claim credit for transportation control measures in its SIP must employ travel forecasting methods that are sophisticated enough to capture the likely effects of such measures. The preferred modeling approach for such areas is the travel demand forecasting process. Alternative methods can be employed if they are analytically sound and clearly documented.

EPA guidance specifies that for SIP submittals made after January 1, 1994, for projection years beyond 1996, the travel demand model must disaggregate peak and off-peak travel, and must achieve self-consistent equilibrium with respect to traffic volumes and trip times in the trip distribution, mode choice, and route assignment analysis portions of the model.

EPA is aware that there is no standardized model for performing traffic simulation or travel demand forecasting. **Thus, it is incumbent upon the MPO performing the travel demand forecasting to provide thorough documentation of the models and** procedures employed to prepare emissions forecasts. Consultation to obtain pre-approval of models and methods is suggested.

For areas that do not currently have a validated travel demand model, short term VMT projections may be based on the Federal Highway Administration's Highway Performance Monitoring System (HPMS) (U.S. DOT, 1987). Also, EPA guidance allows the states to use any reasonable method to project VMT growth outside the domain of the travel demand model and/or HPMS reporting area.

HPMS was developed in the 1970s for monitoring highway conditions, and is a continuing data base that can be used to determine future needs. Data are submitted annually by the states (via their highway agencies) according to roadway functional class. HPMS is of interest to EPA because it will be the basis for estimating base year VMT and then for tracking historical changes in VMT with time.

Areas that only need to project VMT through 1995 or 1996 are allowed to use a simple, historically based extrapolation method, if a better method is not locally available. Because, in general, economic factors influence VMT, areas making projections beyond 1995 or 1996 should include economic variables in their land use and transportation network travel demand models.

b. Trend Procedures

One example of an acceptable procedure for estimating future year VMT, in situations for which travel demand models are not available or required (such as nonattainment area rural fringes not covered by HPMS or a network model), is to apply a trend projection method. This can be done by quantifying road mileage and associated VMT (stratified by county, rural/urban area, and roadway functional class), and using the relationship between road mileage and VMT for historical years to estimate future year VMT. The hypothesis underlying this technique is that for each roadway functional class within a specified geographical area that historical trends reasonably represent short-range future growth.

A more detailed description of this trend projection method follows. The first step is to estimate average annual traffic growth rates for the HPMS classified system. To do this, available HPMS sample panel data should be employed to estimate average annual traffic growth rates by:

- County
- Rural/urban designation/sample site
- Functional class

Roadway functional classes are defined as follows:

Rural	Urban
Interstate	Interstate
Other Principal Arterial	Other Freeways and Expwys
Minor Arterial	Other Principal Arterial
Major Collector	Minor Arterial
Minor Collector	Collector
Local	Local

[Readers interested in more details about roadway functional classifications should consult the Highway Capacity Manual (1985).]

Growth rates should be estimated using a statistically sound procedure to avoid biases that could result from the higher sampling rates in HPMS for higher volume facilities. A procedure that could be used to estimate growth rates, with or without expanded samples (samples in addition to those normally used in HPMS reporting), is as follows:

1. Aggregate earlier year (1985 through 1990) mileage by category.

2. Aggregate earlier year (1985 through 1990) VMT by category.

3. Compute historical VMT per mile in each category from step 1 and 2 results.

4. Compute VMT growth rates using an ordinary least squares linear regression.

The second step, after the average annual HPMS growth rates have been calculated, is to develop traffic volume growth rates for the local street system, which is not covered by HPMS. It is recommended that areas use sample data from the local traffic counting program to estimate average annual traffic growth rates by county, municipal/rural designation, central business district/inner city/suburbs (for municipal streets), and major/minor local street. It may be difficult to collect sufficient samples from within the nonattainment area. (Data from similar counties within the state may be used.) The exact procedure will depend on data availability.

Step three is to estimate base year VMT per mile for the HPMS classified system. To do this, base year VMT per mile can be obtained for each category from sample HPMS data. To ensure that the procedure being used is statistically sound, comparisons should be made with national estimates by urban area size group.

For local street VMT per mile estimates, it is important that the samples used represent the range of volumes on local streets.

Step four is to estimate base and future year road mileage. Base year mileage for the HPMS classified system can be obtained from HPMS. Generally, unless additions are planned, future year road mileage is the same. Base year mileage in each local system category should be obtained from municipalities. Significant additions to this mileage can be expected in the future for suburban municipal streets, and possibly rural streets. Subtractions may be needed in cases where local streets are upgraded to higher functional classifications.

The final step is estimating future VMT. Base year VMT is estimated by category as base mileage * VMT per mile. Growth in VMT is estimated by category as future mileage * VMT per mile * linear growth rate * number of years. Future VMT is obtained by category as base VMT plus VMT growth. Areawide future VMT is estimated by adding the totals of all categories.

Tables III.4 and III.5, along with Figure III.1, provide a practical example using the trend projection techniques described above. Table III.4 presents an example of historical data for the five most recent calendar years by roadway functional class. Urban functional classes are listed. Similar data should be compiled for rural functional classes. Table III.5 presents the corresponding data for road mileage (by urban functional system). The data in these two tables are then used to compute the ratio of annual VMT to road mileage for each year and roadway functional class. Illustrative ratios computed from the data in Tables III.4 and III.5 are shown in Figure III.1.

Because there is significant variability in the relationship between VMT and road mileage from one area to another, each nonattainment area must use data specific to the geographic area of interest when applying this procedure.

c. Vehicle Registration Distributions

EPA's mobile source emission factor models that pre-dated MOBILE 4.1 contained default vehicle registration mixes (vehicle registrations by model year). These values are represented in MOBILE4, for instance, as registration distribution fractions. Registration distribution fractions represent the percentage of vehicles registered from each model year, making up the entire vehicle fleet for a given calendar year and vehicle type. These registration distributions are then used, in turn, to develop travel weighting fractions. Travel weighting fractions are the model year by model year percentages of total travel within each vehicle type.

For preparing 1990 (base year) modeling inventories, EPA is requiring that local registration data be used to establish

Table III.4

Annual Vehicle Miles of Travel by Functional System

Roadway Functional Class (Urban)	Calendar Years					
	1985	1986	1987	1988	1989	1990
Interstate	27,176	27,737	28,650	34,545	36,699	39,382
Other Freeways	25,542	26,029	28,142	25,023	27,666	28,832
Other Prinipal Arterial	28,433	30,587	36,245	36,733	37,590	38,649
Minor Arterial	17,130	17,694	22,941	22,941	23,244	22,995
Collector	6,995	6,112	8,137	8,288	8,664	8,679
Local	6,994	7,172	4,300	12,728	18,113	22,880

* Data are based on state highway agency estimates for the various functional systems.
* See Table III.5 for corresponding road mileages.

Table III.5

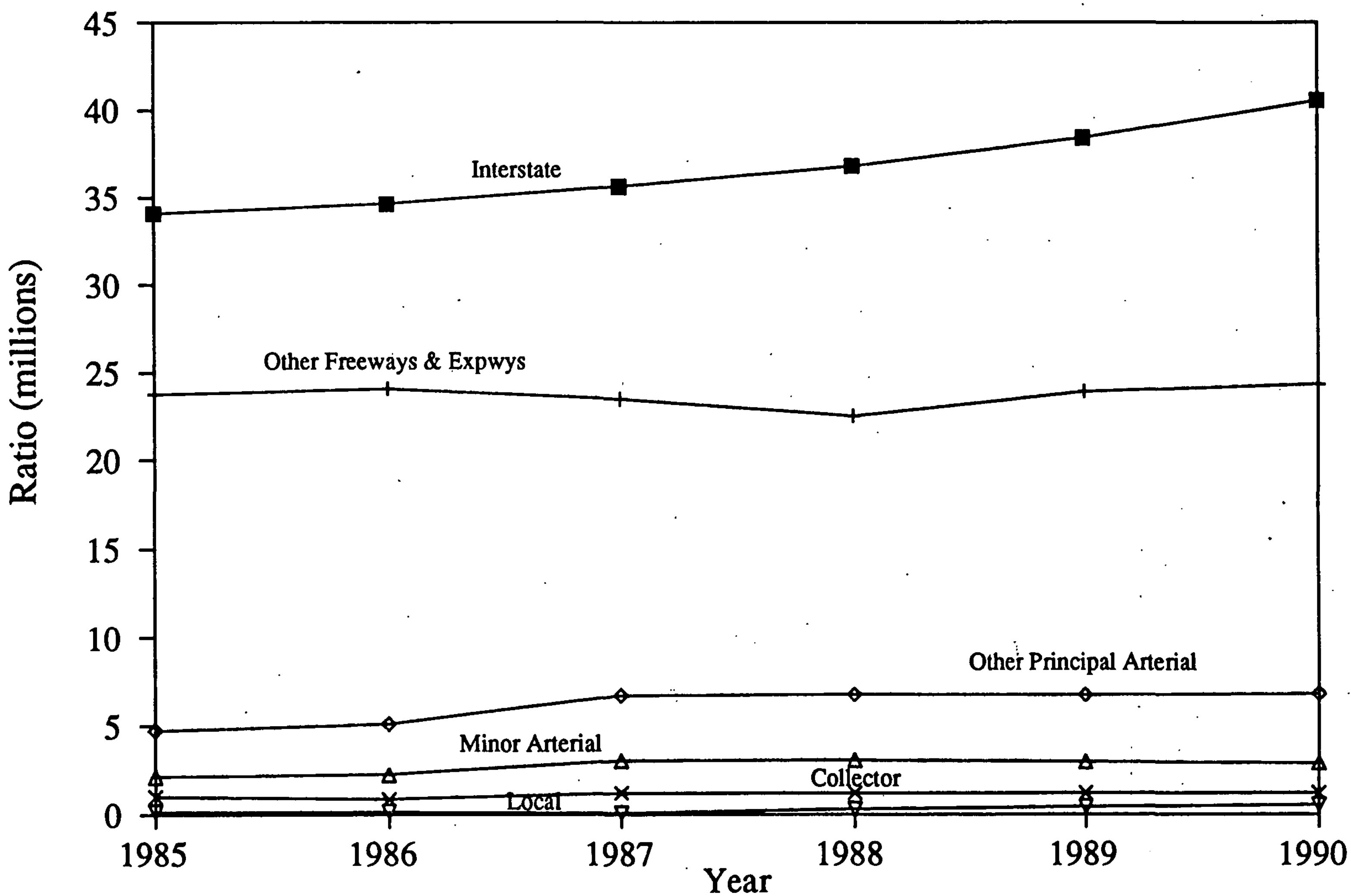
Total Public Road Mileage by Functional System

Roadway Functional Class (Urban)	Calendar Years					
	1985	1986	1987	1988	1989	1990
Interstate	797	800	804	938	955	971
Other Freeways	1,075	1,081	1,200	1,112	1,158	1,186
Other Primary Arterial	5,975	5,999	5,402	5,445	5,593	5,679
Minor Arterial	8,074	7,886	7,483	7,526	7,832	7,950
Collector	6,961	7,213	6,767	6,803	7,238	7,348
Local	39,305	39,934	40,858	41,879	42,123	43,279

* See Table III.4 for corresponding travel estimates.

Figure III.1

Ratio of Annual VMT to Road Mileage by Roadway Functional Class



registration distributions for each vehicle type in MOBILE4.1. (Heavy-duty diesel vehicles may be an exception because so much of heavy-duty diesel truck travel is long haul traffic, and local registrations by county or MSA may not be an accurate, or statistically significant, indicator of travel in an area. National distributions may be better for HDDVs.) Note that MOBILE4.1 assumes that registration distributions reflect the vehicle population operating on July 1. Care should be taken to remove duplicate vehicles from the registration data in compiling the registration distribution. R.L. Polk, Inc. provides this service commercially.

Table III.6 illustrates a methodology that may be followed for projecting vehicle registration fractions from a 1990 base year for input into the MOBILE emission factor model. This analysis, which is amenable to using a spreadsheet, shows how a 1996 ozone (July) projection for light-duty gasoline vehicles would be made for a sample area. Parallel methods may be used for other vehicle types or other projection years. The information in the box below indicates the most important information needed for estimating future vehicle registration distributions.

INFORMATION NEEDED FOR REGISTRATION DISTRIBUTIONS

- 1990 vehicle registrations by model year (derived from local data)
- January 1 or July 1 survival rates by model year
- An estimate of post-1990 model year vehicle registrations

The first column (A) of Table III.6 shows the model years included in the 1990 calendar year registration distribution. (Note that registration data from 25 model years should be used for MOBILE4.1 and its successors, while MOBILE4 required the use of only 20 model years.) Column B shows the number of vehicles registered on July 1, 1990, by model year, which would have been input to MOBILE4.1 to produce a 1990 inventory. These should be local registration data, rather than the default registration data often used in developing inventories for previous base years. Information on registration by model year may be obtained from the state's Department of Motor Vehicles. The age of vehicles from each model year, as of July 1, 1990, is listed in column C.

Data on vehicle survival rates are needed to estimate the number of vehicles registered in 1990 that will still be in operation in the projection year. The **survival rate** is defined as the probability that a vehicle will be in operation at any given year of age. In contrast, the **scrappage rate** is defined as the probability that a vehicle that has reached a given age will

Table III.6

Sample Projection of Car Registration Fractions from a 1990 Base Year

Model Year	Passenger Car Registrations 7/1/90	Vehicle Age 7/1/90	July 1 Survival Rate	Vehicle Age 7/1/96	Survival Rate from 7/1/90 to 7/1/96	Estimated Passenger Car Registrations 7/1/96	Model Year	Vehicle Age 7/1/96	Estimated Passenger Car Registrations 7/1/96	Passenger Car Registration Fractions 7/1/96
1990	7,875	1	0.9967	7	0.8799	9,327	1996	1	9,124	0.0690
1989	10,500	2	0.9906	8	0.8308	8,723	1995	2	11,772	0.0891
1988	10,303	3	0.9813	9	0.7697	7,930	1994	3	11,243	0.0851
1987	10,303	4	0.9674	10	0.6987	7,199	1993	4	10,979	0.0831
1986	10,489	5	0.9470	11	0.6222	6,526	1992	5	10,342	0.0783
1985	10,162	6	0.9176	12	0.5460	5,548	1991	6	9,629	0.0729
1984	9,870	7	0.8769	13	0.4753	4,691	1990	7	9,327	0.0706
1983	7,178	8	0.8230	14	0.4140	2,971	1989	8	8,723	0.0660
1982	6,592	9	0.7553	15	0.3638	2,398	1988	9	7,930	0.0600
1981	6,901	10	0.6759	16	0.3246	2,240	1987	10	7,199	0.0545
1980	6,843	11	0.5892	17	0.2954	2,021	1986	11	6,526	0.0494
1979	7,508	12	0.5010	18	0.2743	2,060	1985	12	5,548	0.0420
1978	6,761	13	0.4168	19	0.2595	1,755	1984	13	4,691	0.0355
1977	5,492	14	0.3407	20	0.2494	1,370	1983	14	2,971	0.0225
1976	3,733	15	0.2748	21	0.2426	906	1982	15	2,398	0.0181
1975	2,193	16	0.2194	22	0.2381	522	1981	16	2,240	0.0170
1974	2,120	17	0.1741	23	0.2351	498	1980	17	2,021	0.0153
1973	1,669	18	0.1374	24	0.2331	389	1979	18	2,060	0.0156
1972	1,259	19	0.1082	25+	0.2318	1,973	1978	19	1,755	0.0133
1971	926	20	0.0850				1977	20	1,370	0.0104
1970	596	21	0.0667				1976	21	906	0.0069
1969	533	22	0.0522				1975	22	522	0.0040
1968	421	23	0.0409				1974	23	498	0.0038
1967	284	24	0.0320				1973	24	389	0.0029
1966+	4,491	25+	0.0251				1972+	25+	1,973	0.0149
Total	135,001					69,047			132,136	1.0000
A	B	C	D	E	F	G	H	I	J	K

be scrapped within a year. For the vehicle registration projections described here, only survival rates are used. Survival rates for automobiles, all trucks, and light trucks were researched by the Oak Ridge National Laboratory for vehicles from 0 to 25 years old (Miaou, 1990). Survival rates will change somewhat over time, as well as by area. Factors influencing these rates include climate, vehicle construction, and economic conditions. Because of these local differences, state or regional survival rates should be used if they are available, but the derivation and source of these local rates must be thoroughly documented. One method of estimating local survival rates is to track vehicle identification numbers through an operating I/M program over the years the program has been in operation. Such a method, however, must allow for the transition of vehicles into and out of the area.

Since the car model year begins October 1, rather than July 1, the base survival rates must be adjusted to reflect the survival rates on July 1. The July survival rate for a car of age n (JSR_n) can be calculated as follows:

$$JSR_n = BSR_{n-1} - (BSR_{n-1} - BSR_n) * 0.75$$

The terms BSR_n and BSR_{n-1} are the base (October 1) survival rates for vehicles of age n and $n-1$, respectively. For a CO nonattainment analysis, 0.25 should replace 0.75 in the equation above. Since the truck model year begins January 1, no adjustment to the base survival rates needs to be made for a CO nonattainment analysis, but the 0.75 in the equation above should be replaced with 0.5 for an ozone nonattainment analysis.

To determine the number of vehicles in a given model year that have survived from 1990 to the projection year, given a 1990 registration distribution, the survival rate for a vehicle of age n in the projection year should be divided by the survival rate for a vehicle of age $n-6$. (For projection years other than 1996, replace 6 with the number of years from 1990 to the projection year.) For example, a 1987 model year car will be 4 years old in July 1990 and 10 years old in 1996, so the probability that the car will survive from 1990 to 1996 is 0.6965/0.9712, or 71.7 percent. The age of each pre-1991 model year car on July 1, 1996, is listed in column E, while column F shows the July 1990 to 1996 survival rates. The number of cars in each model year surviving to the projection year was calculated in column G by multiplying the survival rates of column F by the corresponding 1990 registrations shown in column B.

The number of 1990 model year cars registered in 1996, as shown in column G, is greater than the number of cars registered in 1990, shown in column B. This occurs because the entire 1990 model year fleet has not been sold and registered by July 1. Therefore, a projection of the total number of 1990 model year cars should be made before multiplying by the 1990 to 1996 survival rate in column F.

When projecting the registration distribution to 1996, all vehicles from the 1972 and earlier model years are aggregated in the 25 year-or-older category. The total number of 1990 registrations for 1972 and earlier model years should be added together before multiplying by the July 1990 to 1996 survival rate. This aggregation is emphasized by the shading near the bottom of the spreadsheet.

The model years included in the July 1, 1996 vehicle registration calculation are listed in column H, with the age of each model year car listed in column I. The shift from the 1990 base year to the 1996 projection year is illustrated with the lines connecting columns G and H.

The registrations of column G for the pre-1991 model years are repeated in column J, and the registrations for the 1991 through 1996 model years are added to the top of column J. Projections of future model year new vehicle registrations can be made assuming that annual percentage increases in new vehicle sales will reflect the local annual percentage increases in VMT (generally, about 2-3 percent per year).

The projections for this example indicate no increase in new car registrations from 1989 to 1990, so the number of car registrations for the 1989 model year in column B was divided by the survival rate for a car of age 2 in column C and then multiplied by the 1990 to 1996 survival rate for a vehicle aged 7 years in 1996 (from column F). This gives the estimated passenger car registrations for the 1990 model year in 1996 (in column G).

Once the local annual growth rates in new car registrations have been established, the 1996 registrations for 1991 through 1996 model year cars can be estimated. The following equation can be used to calculate the number of registrations in 1996 for these cars:

$$J_n = (1 + \%growth/100) * J_{n+1} * (D_n/D_{n+1})$$

J and D in this equation refer to the columns in Table III.6, *n* is the vehicle age, and %growth is the annual percentage increase in new car registrations for the applicable model year. The final model year (1996 in this example) should be calculated in the same way and then multiplied by 0.75 since only three-quarters of the 1996 model year cars are assumed to be registered by July 1, 1996. The registration fractions shown in column K, which are the necessary inputs for the MOBILE emission factor model, were calculated by dividing each model year's July 1996 registrations from column J by the July 1996 registration total shown at the bottom of column J.

2. **Aircraft**

Air travel has experienced strong growth in the past several years, and that growth is expected to continue for the foreseeable future. As a result, many existing airports are near traffic capacity and others will reach their capacity limits in the near future. This may cause air traffic at small feeder airports and regional hubs to grow, while current hubs experience additional congestion. Increased congestion increases taxi/idle times (and emissions), but expanded use of smaller airports may relieve some of this congestion.

EPA recommends that major commercial airports be queried individually to determine their specific growth plans (if any), and suggests that this information be incorporated in emission projections. It is not recommended that national trends in aircraft activity be used in urban scale analyses because growth is likely to be site-specific. For example, older, urban area airports such as Washington National are less likely to grow than airports with newly expanded facilities such as Raleigh-Durham.

Projections of increased passenger miles may not be a good indicator of future aircraft activity, as more passengers may be accommodated by adding larger planes to the commercial fleet. These larger planes may be more efficient and cleaner burning than the smaller planes they replace. Projections of landings and take offs are needed.

3. **Railroads**

Potential growth in rail travel is a function of many different variables, including competition with the trucking industry. For any individual area, activity growth is related to track density and expected operations. **The best source of information on likely changes during the projection period is the railroads themselves, either the companies that operate in the metropolitan area, or through the American Association of Railroads.** The American Association of Railroads publishes historical fleet statistics. These are of interest for projections in cases where a short-term trend analysis is the best indicator of future railroad activity.

[The latest edition of Railroad Facts can be obtained by contacting the Information and Public Affairs Department of the Association of American Railroads, 50 F Street, NW, Washington, DC, Telephone (202)639-2550.]

4. **Gasoline Marketing**

Expected growth in gasoline marketing activity is closely tied to projected fuel consumption. A number of national fuel consumption models have been developed over the years, and the most recent results from those models can be used as indicators of growth in activity for the variety of source types that constitute the gasoline marketing category. EPA's Office of Mobile Sources has its own fuel consumption model, and it is designed to be compatible with MOBILE4.1 and MOBILE5. Table III.7 lists the expected fleet fuel efficiency ratios by calendar year for each gasoline vehicle class in MOBILE4.1, normalized to 1990. Total fuel consumed by gasoline vehicles is the sum of that consumed by each gasoline vehicle class. That, in turn, is the product of the number of vehicles in each class and the average number of miles driven by those vehicles divided by the average fuel economy (mpg) of those vehicles.

Forecast the amount of gasoline marketed by:

a. Estimating the amount of 1990 gasoline marketed by vehicle class from available state and local sales data.

b. Multiplying that amount by the appropriate fleet fuel economy factors for the forecast year listed in Table III.7. This product is the amount of gasoline that would be marketed in that year in the absence of any change in vehicle miles traveled (VMT).

c. Multiply the result obtained in (b) by the anticipated change in VMT from 1990 to the forecast year expressed as a ratio of forecast year VMT/1990 VMT. This product is the amount of gasoline marketed that includes both fuel economy changes due to fleet turnover and changes in the total number of vehicle miles traveled in the area under consideration.

Table III.7

MOBILE4.1 Fuel Consumption Model
Normalized On-Road Fleet Gasoline Fuel Efficiency Ratios*

			HDV**					
Year	LDV	LDT	2B-5	6-8A	8B	LDV+LDT	HDV	All
1990	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1991	0.98	0.99	0.99	1.00	1.00	0.98	0.99	0.98
1992	0.96	0.97	0.98	0.99	0.99	0.97	0.97	0.97
1993	0.95	0.96	0.97	0.99	0.99	0.96	0.96	0.96
1994	0.94	0.95	0.96	0.99	0.99	0.95	0.95	0.95
1995	0.93	0.95	0.96	0.98	0.99	0.94	0.95	0.94
1996	0.93	0.94	0.95	0.98	0.98	0.94	0.94	0.94
1997	0.92	0.94	0.94	0.98	0.98	0.93	0.93	0.94
1998	0.92	0.93	0.94	0.98	0.96	0.93	0.93	0.93
1999	0.91	0.93	0.94	0.98	0.93	0.93	0.92	0.93
2000	0.91	0.93	0.93	0.98	0.90	0.93	0.92	0.93
2001	0.91	0.93	0.93	0.98	No Sales	0.93	0.91	0.93
2002	0.91	0.93	0.92	0.98	No Sales	0.93	0.91	0.93
2003	0.91	0.93	0.92	0.98	No Sales	0.93	0.91	0.93
2004	0.91	0.93	0.92	0.98	No Sales	0.93	0.90	0.93
2005	0.91	0.93	0.91	0.98	No Sales	0.93	0.90	0.93
2006	0.92	0.93	0.91	0.98	No Sales	0.93	0.90	0.94
2007	0.92	0.93	0.91	0.98	No Sales	0.94	0.90	0.94
2008	0.92	0.93	0.91	0.98	No Sales	0.94	0.90	0.94
2009	0.92	0.93	0.91	0.93	No Sales	0.94	0.89	0.94
2010	0.92	0.93	0.91	0.98	No Sales	0.94	0.89	0.94
2011	0.92	0.93	0.91	0.98	No Sales	0.94	0.89	0.94
2012	0.92	0.93	0.91	0.98	No Sales	0.94	0.89	0.94
2013	0.92	0.93	0.90	0.98	No Sales	0.94	0.89	0.94
2014	0.92	0.93	0.90	0.98	No Sales	0.94	0.89	0.95
2015	0.92	0.94	0.90	0.98	No Sales	0.94	0.89	0.95
2016	0.92	0.94	0.90	0.98	No Sales	0.95	0.89	0.95
2017	0.92	0.94	0.90	0.98	No Sales	0.95	0.89	0.95
2018	0.93	0.94	0.90	0.98	No Sales	0.95	0.89	0.95
2019	0.93	0.94	0.90	0.98	No Sales	0.95	0.89	0.95
2020	0.93	0.94	0.90	0.98	No Sales	0.95	0.89	0.95

*Fuel efficiency is expressed in gallons per mile. The ratio is unitless.

Note: As of this writing, there are several bills in Congress addressing the issue of Corporate Average Fuel Economy (CAFE). Table III.7 assumes that CAFE standards do not change from current levels. If Congress increases CAFE requirements in the future, EPA will revise Table III.7 accordingly.

**Classes 2B-5 trucks weigh 8,500 to 19,500 lbs, 6-8A are 19,501 to 50,000 lbs, and 8B 55,001 lbs or more.

SOURCE: MOBILE4.1 Fuel Consumption Model, August 12, 1991.

IV MEASURING THE EFFECTS OF CURRENT AND FUTURE CONTROLS

This chapter describes how ozone and CO nonattainment areas can include the probable effects of current and future controls on precursor emissions in their projections. The information presented here is organized by pollutant (VOC, NO_x, and CO, in that order) and by major emitting-source category for each. The focus of the chapter is on new control initiatives spurred by the CAAA. Because mobile source controls affect all three of the pollutants of interest, they are discussed in a separate section.

A. VOLATILE ORGANIC COMPOUNDS

The discussion of CAAA requirements affecting VOC emissions is organized according to the following:

(1) National stationary measures
(2) Motor vehicle measures
(3) Area-specific measures
(4) Discretionary measures

The first three types of measures are those considered mandatory under the CAAA or other legislation, unlike discretionary measures, which are **elective**, as explained below.

National stationary measures are those that affect all sources nationwide, whether or not they are located in nonattainment areas. Source categories affected by national stationary measures in the CAAA or other legislation include the following:

- Hazardous Waste Treatment Storage and Disposal Facilities (TSDFs)
- Municipal Landfills
- Consumer/Commercial Solvents
- Architectural Coatings
- Marine Vessels (loading and unloading)

In modeling of the above categories, it can be assumed that VOC emission reductions from all of these categories except consumer/commercial solvents will have occurred by 1995. Consumer product rules are scheduled to be issued in four 2-year intervals beginning in the period from 1994 to 1995, and ending in the period from 2000 to 2001.

Motor vehicle measures include a mix of national and area-specific measures. National measures (those that affect all areas) include gasoline Reid Vapor Pressure (RVP) limits, evaporative/running loss controls, tailpipe/extended useful life standards, and onboard vapor recovery systems. Area-specific measures include stage II (service station) controls, fleet clean fuels programs, and reformulated gasoline. (The only general vehicle clean fuels program mandated is for California only.)

Reformulated gasoline is mandated in the nine cities with the most severe ozone pollution beginning in 1995. Those cities are listed in Table IV.1. States can elect to have the requirements apply in other cities.

Reformulated gasoline will be required to reduce VOC and toxic emissions by 15 percent by 1995. Higher reductions (of 20 percent or more) are required by 2000.

The fleet vehicle clean fuels program is designed to include areas in serious, severe, and extreme ozone nonattainment with populations of at least 250,000 and areas with a CO design value greater than or equal to 16.0 ppm with a population of at least 250,000. A list of the fleet clean fuels target areas are included in Table IV.1. Clean fuel vehicle phase-in requirements for fleets are as follows:

Vehicle Type	MY1998	MY1999	MY2000
LDVs and LDTs	30%	50%	70%
HDTs	50%	50%	50%

(Standards that **must** be met by clean fuel vehicles are listed in Sec. 243 of the CAAA.)

Area-specific measures include RACT for stationary sources that emit at least 50 tons per year of VOC in serious ozone nonattainment areas, with the cutoff dropping to 25 tons in severe nonattainment areas, and to 10 tons in extreme nonattainment areas (Los Angeles). Control technique guidelines for VOC sources are to be issued for 11 stationary source categories. These new CTGs are to be applied in moderate, serious, severe, and extreme ozone nonattainment areas. Table IV.2 lists the specific new CTGs that are expected as of this writing. Table IV.3 lists existing CTGs applied in ozone nonattainment areas. Table IV.4 lists VOC RACT controls applied as listed above. Enhanced inspection and maintenance programs are also required in the CAAA for serious, severe, and extreme ozone nonattainment areas. Basic inspection and maintenance (I/M) is to be required in moderate ozone nonattainment areas.

The other area-specific measures are those for attainment areas within the ozone transport region. The ozone transport region includes CT, DE, ME, MD, MA, NH, NJ, NY, PA, RI, VT, and the Washington, DC CMSA. Ozone transport region controls include enhanced I/M (if the MSA population is 100,000 or more), existing and new CTGs, RACT to greater than 50 tons per year VOC sources, and a study to determine whether stage II vehicle refueling controls should be required.

Table IV.1

CAAA Mandated Motor Vehicle Programs

Reformulated Gasoline Areas	Clean Fuels Areas--Fleet Programs
1. Los Angeles, CA	1. Atlanta, GA
2. New York, NY-NJ-CT	2. Fresno, CA
3. Chicago, IL-IN-WI	3. Milwaukee, WI
4. Houston, TX	4. Bakersfield, CA
5. Baltimore, MD	5. Baltimore, MD
6. Milwaukee, WI	6. Baton Rouge, LA
7. Philadelphia, PA-NJ-DE-MD	7. Beaumont, TX
8. San Diego, CA	8. Chicago, IL-IN-WI
9. Hartford, CT	9. El Paso, TX
	10. Greater Connecticut
	11. Houston, TX
	12. Los Angeles, CA
	13. Boston, MA-NH
	14. New York, NY-NJ-CT
	15. Philadelphia, PA-NJ-DE-MD
	16. Providence, RI
	17. Sacramento, CA
	18. San Diego, CA
	19. Washington, DC-MD-VA
	20. Denver, CO
	21. Springfield, MA

SOURCE: Environmental Protection Agency, Office of Mobile Sources

Table IV.2

Proposed New Control Technique Guidelines (CTGs) Under the CAAA

1. Synthetic Organic Chemical Manufacturing Industry (SOCMI) Reactor Processes
2. SOCMI Distillation Operations
3. Plastic Parts (Business Machines) Coatings
4. Plastic Parts Coatings (Other)
5. Web Offset Lithography
6. Autobody Refinishing
7. Industrial Clean-Up Solvents
8. Petroleum and Industrial Wastewater
9. Wood Furniture Coating
10. SOCMI Batch Processes
11. Volatile Organic Liquid Storage Tanks

SOURCE: Environmental Protection Agency, Office of Air Quality Planning and Standards

Table IV.3

Estimated Control Efficiencies of Existing CTG Controls

Source Category	Estimated VOC Emission Reduction (%)
Solvent metal cleaning	54%
Printing and publishing	85
Dry cleaning	70
Fixed roof crude tanks	98
Fixed roof gasoline tanks	96
EFR crude tanks	90
EFR gasoline tanks	95
Bulk gasoline terminals -- splash loading	91
Bulk terminals -- submerged, balanced	87
Bulk gasoline terminals -- submerged	79
Service stations - stage I	95
Petroleum refinery fugitives	69
Petroleum refinery vacuum distillation	100
Rubber tire manufacture	83
Green tire spray	90
Automobile surface coating	88
Beverage can surface coating	57
Paper surface coating	78
Degreasing	35*
Cutback asphalt	100*
Gasoline bulk terminals and plants	51*
Pharmaceutical manufacture	37*
Oil and natural gas production fields	37*
Service stations - stage I	76*

SOURCE: Compiled from EPA, 1978, and the individual Control Technique Guideline Documents

Control efficiencies listed represent the mid-point of a range of control effectiveness. These can be adjusted upward or downward to reflect State and local regulations or differences in source characteristics by area.

*Control efficiencies listed for these source categories are intended for application where these sources have been inventoried as area sources. The 78 percent control efficiency listed for paper surface coating applies to both point and area sources. All other control efficiencies shown are designed to be applied to point sources.

Table IV.4

Representative Stationary Source VOC RACT Control Levels

Source Category	Estimated VOC Emission Reduction (%)
Ethylene oxide manufacture	98%
Phenol manufacture	98
Terephthalic acid manufacture	98
Acrylonitrile manufacture	98
SOCMI fugitives	37
Cellulose acetate manufacture	54
Styrene-butadiene rubber manufacture	70
Polypropylene manufacture	98
Polyethylene manufacture	98
Ethylene manufacture	98
Vegetable oil manufacture	42
Carbon black manufacture	90
Miscellaneous surface coating	90
Coke ovens - door and topside leaks	90
Coke oven by-product plants	63
Aircraft surface coating	79
Whiskey fermentation - aging	85
Charcoal manufacture	80
Synthetic fiber manufacture	54
Miscellaneous non-combustion	90

SOURCE: Battye et al., 1987

Control efficiencies listed represent the mid-point of a range of control effectiveness. These can be adjusted upward or downward to reflect State and local regulations or differences in source characteristics by area.

Discretionary measures, as defined here, are measures that areas might choose to undertake to supplement mandatory measures (described above). Areas may chose additional measures in the interest of reaching attainment or to meet progress requirements. Depending on problem severity, ozone nonattainment areas must attain the standards within 5, 10, 15, or 17 years (20 years for Los Angeles). VOC emissions must be reduced by 3 percent per year until the standard is attained. For the purposes of attainment demonstrations, discretionary measures are important to identify for areas not expected to meet the standard with mandatory measures alone.

Table IV.5 summarizes all of the above for VOC emission related Title I and II requirements of the CAAA. Dates when each of these measures are scheduled to start affecting VOC emissions are also listed in this table. [Appendix B of EPA's "Implementation Strategy for the Clean Air Act Amendments of 1990" (U.S. EPA, 1991a) shows timelines for Titles I through IV of the Amendments.]

Two parts of the nonattainment program that are difficult to quantify, but which have an effect on future VOC emissions, are offsets and new source review. Offsets differ for each category (moderate, serious, etc.) of ozone nonattainment area. Presumably, offsets either act to restrict growth in nonattainment areas, or they force new emitters to assist existing facilities in achieving emission reductions.

Title III of the CAAA calls for controls of many new toxic-compound-emitting source categories. Most of these controls will affect VOC emissions. From a modeling standpoint, the potential reductions can be quantified by matching source categories to be regulated with AIRS Facility Subsystem SCCs. The Emissions Standards Division of OAQPS is responsible for developing a list of potentially affected categories and associated emission reductions.

There are also potential VOC reductions that will be observed at companies that have agreed to make voluntary reductions in their toxic emissions. These agreements were made before the CAAA were passed, and are part of EPA's Early Reduction Program, so it may be that reductions will be close in magnitude to those that will now be required under Title III. Each state agency with a nonattainment area needs to determine whether there are firms in its area that are planning voluntary reductions and what the timing of those reductions might be.

B. OXIDES OF NITROGEN

NO_x emissions are also affected by the CAAA. Titles I (Nonattainment), II (Motor Vehicles), and IV (Acid Rain) all come in to play. Title I requires RACT on major stationary-source NO_x emitters in moderate, serious, severe, and extreme nonattainment

Table IV.5

CAAA Provisions Summary

Classification of O_3 Nonattainment Areas and Deadlines

Classification	Design Value	Attainment Date
Marginal	.121 - .137 ppm	1993
Moderate	.138 - .159	1996
Serious	.160 - .179	1999
Severe	.180 - .279	2005 or 2007*
Extreme	.280 and above	2010

Motor Vehicles

- Enhanced I/M in serious, severe, and extreme nonattainment areas [before 1995]
- Basic I/M in moderate nonattainment areas [before 1995]
- Stage II vehicle refueling controls in moderate, serious, severe and extreme nonattainment areas (if onboard is promulgated before Stage II, no new stage II in moderate areas) [before 1995]
- Onboard vehicle vapor recovery systems [phase-in starting in 1996]
- Improved evaporative test procedures [before 1995]
- Gasoline volatility controls [before 1995]
- New emission standards for LDVs and LDTs [phase-in starting at 40% in 1994, 80% in 1995, and 100% in 1996]
- Reformulated gasoline in 9 areas ($\geq$ 0.18 ppm 0_3) [starting in 1995]
- Fleet vehicle clean fuels programs in serious, severe, and extreme ozone nonattainment areas and CO areas with a design value of 16.0 ppm or more (>250,000 MSA population only) [starting in 1998 with phase-in to 2000]
- California general vehicle clean fuels program [start at 150,000 vehicles in 1996, increase to 300,000 in 1999, more stringent standards starting in 2001]

Table IV.5 (continued)

Stationary Sources

- National measures control hazardous waste Treatment Storage and Disposal Facilities (TSDF), architectural coating, commercial/consumer solvent, vessel loading and unloading, and landfill emissions [before 1995, except consumer solvents]

- RACT for greater than 50 tpy emitters in serious, 25 tpy emitters in severe, and 10 tpy emitters in extreme nonattainment areas [before 1995]

- 11 Control Technique Guidelines in moderate, serious, severe, and extreme ozone nonattainment areas [before 1995]

- For consumer or commercial products, list categories that account for at least 80 percent of the VOC emissions. The list will be divided into 4 groups for regulation. Every 2 years regulate one group [all implemented between 1995 and 2001].

Moderate, serious, severe and extreme ozone nonattainment areas must achieve 15 percent VOC emission reductions net of growth and noncreditable emission reductions by 1996 and 3 percent per year thereafter until attaining.

Ozone transport region controls [before 1995] include enhanced I/M, existing and new CTGs, RACT to 50 tpy VOC sources, RACT to 100 tpy for NOx sources, and Stage II vehicle refueling [study only].

*Severe ozone nonattainment areas with a 1988 ozone design value between 0.190 and 0.280 ppm have an attainment date of 2007.

areas, where the definition of major source is the same as it is for VOC emitters. In addition, RACT is required for greater than 100 ton per year NO_x sources in ozone transport regions. The controls considered NO_x RACT for prior CAA analyses, along with estimated control efficiencies, are listed in Table IV.6. There are increasingly stringent motor vehicle NO_x emission standards in Title II, which should provide significant reductions in emissions for that sector. For example, the 0.4 gram-per-mile NO_x emission standard for light-duty gas vehicles and light-duty gas trucks begins to be phased in with 1994 model year vehicles, and is fully phased in by the 1996 model year. Finally, utility NO_x emissions are affected by Title IV provisions.

1. Electric Utilities

In addition to limiting the amount of SO_2 emitted by electric utilities, Title IV of the CAAA also limits the amount of NO_x emitted by electric utilities. The overall targeted NO_x reduction from Title IV, in combination with other provisions of the Act, is approximately 2 million tons from 1980 emission levels in the 48 contiguous states and the District of Columbia.

Unlike the SO_2 control requirements of the CAAA, NO_x utility emissions are not capped; the Act only imposes emission rate limits based on utility boiler type.

When projecting electric utility NO_x emissions from a 1990 base year inventory, emission estimates from existing units, planned units, and new sources not yet in the planning stages must all be compiled. Calculating future emissions from existing sources involves determining: (1) state-level growth factor by fuel type, (2) future year unit-level capacity factors, and (3) new NO_x control requirements from the CAAA, as well as any state- or local-level control requirements. Calculating future emissions from planned units includes the following steps: (1) obtaining a listing of planned units, their capacities, and start dates, (2) determining the likely site for units with undesignated locations, and (3) determining applicable defaults for all of the unknown variables needed for the NO_x emission calculation. Finally, to calculate NO_x emissions from any additional generation requirements within the state, the following steps must be followed: (1) determine the amount of additional generation needed that will not be supplied by existing or planned units, (2) determine the likely fuel mix to be used, and (3) site the additional generation. These are summarized in the chart on the page following Table IV.6.

Table IV.6

Stationary Source RACT Controls for NO_x

Source type - Primary Fuel	Estimated RACT Control Technique	Emission Reduction(%)
Ind boiler-pulv. coal	Staged combustion air/LNB	36%
Ind boiler-stoker	Low excess air	21
Ind boiler-residual oil	Staged combustion air/LNB	42
Ind boiler-distillate oil	Low excess air/LNB	36
Ind boiler-gas	Flue gas recirculation/LNB	31
IC engines-gas	Change air to fuel ratio	30
IC engines-oil	Change air to fuel ratio	30
Gas turbines-gas	Water injection	70
Gas turbines-oil	Water injection	70
Process heaters-gas	Staged combustion air	45
Process heaters-oil	Staged combustion air	45

SOURCE: Pechan, 1988.

ELECTRIC UTILITY NO_x
PROJECTIONS SUMMARY

1. Estimate emissions from existing units:
   - determine state-level growth factors
   - estimate unit-level future year capacity factors
   - determine unit-level NO_x control requirements
2. Estimate emissions from planned units:
   - obtain listing of planned units
   - determine most likely siting for undesignated units
   - determine applicable unit-level NO_x emission rates (and default data)
3. Estimate emissions from generic units:
   - determine amount of additional generation needed (if any)
   - estimate NO_x emission rate
   - determine siting for generic units

To project 1990 utility NO_x emissions to a future year, the expected growth in electricity generation at existing units from 1990 to the projection year must be determined. A state-level growth factor can be calculated based on historical growth in generation at existing utility units in the state, or from estimates provided by utilities within the state. Growth factors may differ for coal, oil, and gas-fired utility units. These growth factors should be multiplied by each unit's 1990 capacity factor (the ratio of a unit's actual 1990 generation to the potential generation if operated for 8,760 hours per year), to produce a unit-specific capacity factor in the projection year. If the calculated projection year capacity factor is greater than 0.80, 0.80 should be used as the projection year capacity factor, unless the 1990 capacity factor also exceeds 0.80 (in which case the 1990 capacity factor should be used in the projection year). (Capacity factors for utility units are rarely above 0.8.) For states with a growth factor of less than 1, the projection year capacity factors will be less than the 1990 capacity factors.

Once the future year capacity factors for each existing unit have been calculated, the most stringent of the Federal, state, and local NO_x emission rate requirements must be determined for each unit. The NO_x emission control requirements of Title IV of the CAAA become effective for a given unit when that unit becomes an "affected" SO_2 unit. Phase I affected SO_2 units are those that must apply SO_2 controls beginning in 1995. These units, which are specifically listed in the CAAA, are also listed in Table A-2. The NO_x control requirements (including the compliance dates for these affected units) are as follows:

Boiler Type	Controlled NO_x Emission Rate ($lb/10^6$ Btu)	Date of Compliance
Tangentially-fired	0.45	1/1/95
Dry Bottom Wall-fired	0.50	1/1/95
All Other Boiler Types	1.00	1/1/97

Using the emission rates listed above, the future year capacity factor, the capacity, and the heat rate (the amount of energy needed to produce a given unit output) of a given unit, the projected NO_x emissions can be calculated with the following equation:

$$\underset{\text{(k tons/yr)}}{\text{Future } NO_x \text{ Emissions}} = \underset{(lb/10^6\ Btu)}{\text{Controlled } NO_x \text{ Rate}} * \underset{(MW)}{\text{Capacity}} * \underset{\text{Factor}}{\text{Future Capacity}} * \underset{(Btu/kWh)}{\text{Heat Rate}} * 4.38 * 10^{-6}\ \text{Bt}$$

The final term in this equation is a conversion factor that converts the units used for the variables in the equation to a resultant emissions figure in kilotons per year. Units for the conversion factor are (kWh * k tons)/(MW * year * lb).

Beginning in 2000, Phase II SO_2 units (all utility boilers not included in Phase I) become "affected." Therefore, the NO_x control requirements listed above will apply to all Phase II SO_2 units starting in the year 2000. In Phase I and Phase II, if the current (1990) NO_x emission rate for a unit is already below that unit's control requirement, the 1990 emission rate should be used.

Retirements of existing units must also be taken into consideration. When information on the planned year of retirement for a specific unit is not available, an assumption of 55 to 65 years in service is acceptable. The higher figure has been used by EPA in a number of analyses of the CAAA to represent a "high emissions case" for fossil fuel units, while 55 years has been used to depict a "low emissions case" (ICF, 1990).

After NO_x emissions from existing units have been calculated, the next step is to estimate NO_x emissions from planned or announced units. Information on units that are expected to begin operation over the next 10 years are published annually in the "Inventory of Power Plants in the United States" (DOE, 1991). [This publication is available from the Superintendent of Documents, U.S. Government Printing Office -- see Reference section of this document.] The current listing of units projected to begin operation from 1990 to 1999 from Table 21 of this publication is reproduced in Appendix A of this report.

The NO_x emission rate that applies to each new unit depends on the start-up year and the fuel type, since the NO_x regulations that apply to these units will either be the current New Source Performance Standard (NSPS) or a more stringent NSPS, revised by 1994 as set forth in the CAAA. All NO_x emission rate requirements from the CAAA for utility boilers are listed in Table IV.7. For these units, when no more detailed information is available, a default capacity factor of 0.65 can be assumed for a baseload unit, 30 percent for an intermediate load unit, and 10 percent for a peaking unit. Default heat rates by unit technology and fuel type can be found in EPRI's "Technical Assessment Guide" (EPRI, 1986).

The information on announced units in the "Inventory of Power Plants in the United States" (U.S. DOE, 1990) includes the county that the unit will be located in, if this information is known. When it is necessary to site an undesignated unit at the county or MSA level, it can be assumed that the maximum new unit generation that would be sited within a nonattainment MSA would be used to compensate for units that were recently retired in the MSA. Any additional new units, that do not have a county or MSA designation, can be assumed to be sited outside of any nonattainment MSAs.

The last step that must be taken is to determine whether the generation supplied by existing and announced units will meet the state's generation needs in the projection year. The total projected generation demand could possibly be obtained from the public utility commission in the state, utilities located within the state, or a computer model capable of making this projection based on state-specific information. The generation that will be supplied by existing and planned units in the projection year must then be compared with the projected total generation demand from in-state utilities. If projected demand exceeds supply, the emissions from additional new units must be accounted for.

The amount of additional generation required to meet the electricity demands within the state in the projection year should be assumed to be supplied by new "generic" units. All new generating units will be subject to the NSPS requirements. Unless this demand is expected to be met using a single fuel type, the NSPS for coal, oil, and gas must be weighted together according to the amount of generation supplied by each fuel type in the projection year at existing and announced units. This weighting should be performed as follows:

$$\begin{array}{l}\text{Proj. Yr.}\\ \text{Fuel-Wtd}\\ NO_x\ \text{NSPS}\end{array} = \frac{\text{Proj. Yr. Coal Gen.}*0.5 + \text{Proj. Yr. Oil Gen.}*0.3 + \text{Proj. Yr. Gas Gen.}*0.2}{\text{Total Generation from Existing + Announced Units}}$$

In the above equation, 0.5, 0.3, and 0.2 are the NSPS requirements for coal, oil, and gas, respectively, in lb/10^6 Btu in the projection year. The projection-year coal, oil, and gas generation are calculated by finding the product of the overall capacity, the future capacity factor, and 8,760 hr/yr for existing and planned units in each primary fuel category.

Table IV.7

CAA NO_x Emission Limits for Utility Boilers for 2000 and Later

Primary Fuel Type	Boiler Configuration	Initial Year of Operation	NO_x Emission Limit (lb/MMBtu)
Natural Gas	All Configurations	1983 and Later	0.20[1]
Oil	All Configurations	1983 and Later	0.30[1]
Coal, Oil, or Natural Gas	Tangentially-fired	All Years	0.45[2]
Coal	All Configurations	1994 and Later	0.50[3]
Coal, Oil, or Natural Gas	Dry Bottom Wall-fired	All Years	0.50[2]
Subbituminous coal	All Configurations	1983 to 1993	0.50[1]
Bituminous or Anthracite Coal	All Configurations	1983 to 1993	0.60[1]
Coal, Oil, or Natural Gas	Wet Bottom Wall-fired	All Years	1.00[4]
Coal, Oil, or Natural Gas	Cyclone	All Years	1.00[4]
Coal, Oil, or Natural Gas	Cell Burner	All Years	1.00[4]
Coal, Oil, or Natural Gas	All Configurations	All Years	1.00[4]

Note: If a boiler falls into more than one of the above categories, only the most stringent emission limit applies.

SOURCES:
1 40 CFR, Part 60, Subpart Da, New Source Performance Standards (NSPS).
2 Clean Air Act Amendments of 1990.
3 Assumed new NSPS resulting from requirements of CAAA of 1990 to revise NSPS for coal-fired utility boilers.
4 Assumed retrofit control level resulting from requirements of CAAA of 1990.

Using this NO_x emission rate, the NO_x emissions from the "generic" new units can be calculated, as for the other types of units, by substituting the generation required by generic units (in MWh) for the term **capacity * future capacity factor * 8,760** in the equation given above for calculating future year NO_x emissions, and using the same heat rate as is assumed for announced units. The same siting assumptions should be used for generic units as the one discussed above for the undesignated announced units.

2. Non-Utility Generators

Now electric utilities meet the demand for power not just by building new generating units, but also by buying power from others. It is therefore important to consider the potential new emissions from co-generators and independent power producers when performing emissions projections. It is also important to determine whether any of the shortfall between projected electricity demand for a region and projected new utility unit construction will be filled by "purchased power." Any NO_x emission projections should account for this source sector, and should ensure that new demand being met by these units be subtracted from that expected to be met by the utilities themselves. From a modeling standpoint, the location of the source providing generation is very important. If the co-generator or independent power source is located within the boundaries of the area being modeled, then the NO_x emissions from the source must be included. On the other hand, if the source is located outside of the modeling boundaries, its NO_x emissions should not be included.

3. Industrial Sources

The most straightforward method for estimating future industrial NO_x emissions in an area is to apply the RACT-level controls noted in Table IV.6 to the population of units above the applicable source-size cutoff for the nonattainment area. Then, state-level, 2-digit SIC BEA earnings projections can be used to estimate growth in emissions to future years. More complex analyses would include the effects of fuel prices on the decisions that plants with boilers make about whether to install hardware to reduce emissions while continuing to burn the same fuel, or whether to switch fuels to avoid incurring the hardware costs. Decisions about how to fuel newly constructed units may also be influenced by new RACT requirements. This may make it more likely that new units will be smaller (to avoid installing controls) or that they will be sited outside the nonattainment area boundaries. Requirements for NO_x RACT controls for greater than 100 ton-per-year emitters in the Northeast Ozone Transport Region probably eliminates concerns about siting outside nonattainment area boundaries for that region since NO_x RACT control requirements are uniform throughout this entire region, regardless of the attainment status.

C. CARBON MONOXIDE

Future carbon monoxide emissions are affected by both the Title I nonattainment provisions for CO nonattainment areas and the motor vehicle related provisions in Title II. CO nonattainment areas are classified as either moderate or serious, with serious areas being those with design values of 16.5 ppm and above. Primary standard attainment dates are December 1995 for moderate areas, and December 2000 for serious areas. Basic I/M programs are required in moderate areas that do not already have them. Enhanced I/M programs are required for areas with a CO design value greater than 12.7 ppm. Oxygenated gasoline is required in all CO nonattainment areas. More specifically, Sections 187(b)(3) and 211(m) together require that a state containing a CO nonattainment area must require that, by November 15, 1992, fuel sold or supplied (or offered for sale or supply) within the larger of the Consolidated Metropolitan Statistical Areas (CMSAs) or MSAs must contain 2.7 percent oxygen by weight during the period of high CO concentrations.

(Title II provisions affecting CO emissions include new emission standards for light-duty trucks and cold temperature CO standards.)

In some CO nonattainment areas, wood burning stove emissions contribute to CO ambient standard exceedances. In 1988, the wood stove NSPS was promulgated ("New Residential Wood Heaters" 53 FR 5860, 1988). Thus, new wood stoves manufactured after this date will be much cleaner burning than previous ones. AP-42 emission factors for combustion in residential wood stoves show the difference between Phase II unit (wood heaters meeting NSPS after July 1, 1990) emission rates and those of conventional units (U.S. EPA, 1990). CO emission reductions of 70 to 80 percent are expected for catalytic and pellet fired Phase II units. Conventional versus Phase II unit emission factors are scheduled for inclusion in AP-42, Supplement D (September, 1991).

There are also certain state and local regulations that restrict growth in wood stove emissions that should also be taken into account in CO emission projections. For example, the State of Colorado regulations limit CO emissions to 200 g/h.

D. MOBILE SOURCES

1. Highway Vehicles

EPA issued MOBILE4.1, an updated version of its motor vehicle emission factor model, in July 1991. States are required to use MOBILE4.1 in determining 49-state and territories motor vehicle emission factors for all base year emission inventories under the CAAA, adjusted base year inventories, and CO projection inventories. (MOBILE4.1 does not apply to California vehicles.) MOBILE5 is scheduled to be issued November 1991 or as soon as possible thereafter. MOBILE5 will incorporate assumptions about the VOC and NO_x emission reductions of the mandated motor vehicle measures of the CAAA (MOBILE4.1 already includes the CO reductions), as well as the benefits of the current Federal Motor Vehicle Control Program. Specific guidance about estimating future year motor vehicle emission rates will accompany the release of MOBILE5.

An updated version of Procedures For Emission Inventory Preparation, Volume IV: Mobile Sources is scheduled for release in Summer 1991 and will contain information relevant to projecting both on-road and off-road mobile source emissions.

2. Railroads

Diesel engine equipment used by major Class A railroads has undergone significant modernization in the last decade. Emission rates have decreased, so EPA is publishing new emission factor guidance. Downward trends in HC and CO emissions have been observed, while NO_x emissions have stabilized or increased slightly. New engines are cleaner and more fuel efficient, and are serviced more frequently. Another trend is toward higher horsepower engines; soon two locomotives may be able to perform the work of three. These trends are reflected in the recently revised base year emission inventory guidance for this category.

Decisions are scheduled to be made by EPA over the next five years about how to regulate new locomotives. Because fleet turnover is slow, new standards will not have much of an emissions impact before 2000. The State of California is examining the possibility of using smoke to detect violations of emissions standards. High diesel engine smoke levels are indicative of a malfunctioning engine, which is typically caused by malmaintenance and/or tampering. High smoke levels can be closely correlated with high PM emission levels (Jacobs et al, 1991).

(Alternatives to diesel fuel are also being investigated by the railroad industry and may affect future year emission rates.)

3. Aircraft

Aircraft HC emission standards for newly manufactured engines were established in 1984 and have led to declines in fleet average emission factors. This trend is reflected in the recently revised base year emission inventory guidance for this category.

Airlines continually acquire newer aircraft, gradually phasing out older models. While commercial aircraft often remain in service for more than 25 years, fleet turnover phases out aircraft using engines that do not meet the federal HC emission standard.

Airport noise regulations also are forcing changes to the commercial aircraft fleet. National noise regulations, which were recently passed by Congress, are forcing airlines to phase out the use of loud aircraft by 2000. This can be accomplished by retiring the loud, older aircraft; replacing their engines with newer, quieter ones; or modifying the engines to muffle the noise. The first two alternatives result in aircraft with reduced emissions. Because this legislation is so new, the airlines have yet to formulate plans for addressing these requirements. However, as the equipment is updated, changes to the fleet will be reflected in the Federal Aviation Administration's reports on aircraft activity. Since there is a significant engineering and development leadtime for producing new aircraft engines, most of the commercial aircraft to be added to the fleet in the next five to seven years will be powered by engines whose emissions are characterized in Supplement D to AP-42.

4. Non-Road Engines and Vehicles

The CAAA require EPA to study non-road engine and vehicle emissions to determine whether they cause or significantly contribute to air pollution episodes. The CAAA require that this study be completed by November 1991 and be used by EPA to determine whether non-road engines and vehicles contribute to nonattainment problems. It is further required that EPA promulgate, by November 1992, any appropriate emission regulations for non-road engines and vehicles.

The categories of non-road engines to be regulated will be determined after the comment period for the November 1991 study. By the following November, more specific information should be available on expected control techniques and their control effectiveness. In the meantime, the State of California is currently developing regulations for non-road engines and vehicles (CARB, 1990). The California Air Resources Board (CARB) has issued guidance containing estimates of control effectiveness for those future California regulations to local air quality planning authorities in that state. California's estimates may be useful in anticipating the benefits from any future EPA regulations. EPA's base year emission inventory guidance for estimating off-road equipment populations should also be consulted for information relevant to projections.

V COMBINING GROWTH AND CONTROL EFFECTS

A. OPTIONS

When a state or MPO gets to the point where it needs to estimate the combined effects of activity growth and emissions control on air pollution emissions for a projection year, choices need to be made about the level of detail at which it is desirable to perform the calculations and report the results. Three options can be identified (there are certainly others) that are representative of approaches that have been tested. They are listed below.

(1) Aggregating all base year emissions and control information at the county level and performing all projections on that basis.

(2) Allocating all base year emissions to grid cells compatible with the Urban Airshed Model, and estimating future changes in emissions for each grid cell/source category combination.

(3) Retaining source-specific information in the base year inventory and performing point source projections on a source-by-source basis (with area source emission projections performed at the county level).

Advantages and disadvantages to each of these three approaches do exist, so a selection among the approaches should be made by considering them separately, as well as by using the criteria described in the Overview section of Chapter I of this report as a guideline. It is also important to consider the potential projection approach when compiling the base year emission inventory, so that any data needed for a projection approach can be efficiently collected at that time.

Option 1 is the most computationally efficient method for performing projections, but is likely the most problematic for preparing inputs to a grid-based modeling approach. Advantages of this approach include the ability to quantify the effects of some policies, such as new source review and emission offsets, that are not amenable to analyses when source-by-source detail is used to estimate emissions. Another advantage is the ability to incorporate assumptions about plant retirement rates in the emission calculations. Offsetting these advantages is the loss of detail about source characteristics, including current controls and their control effectiveness, that occurs when emissions are aggregated at the source category/county level. Aggregating information also creates potential problems for performing quality control functions, in that errors may be difficult to pinpoint. Cost per ton values can be used to estimate control costs with this approach.

Option 2 is an approach that has been used by the South Coast Air Quality Management District (see Chapter VII for a more detailed example). For an area interested in grid-based modeling, this approach produces emission forecasts that are compatible with data input requirements. An accurate application of such an approach relies on the ability of the emissions modeler to select source categories in a way that minimizes differences in control levels and control techniques with the modeling domain. It also relies on there being little change in the spatial distribution of emissions from the base year to the projection year. In this approach, growth and control factors are the same for each source category (see Tables VII.1 and VII.2 for examples). If control costs are of interest, the detailed cost computations at the source level have to be made outside the modeling framework. The resulting cost effectiveness values (cost per ton) can then be used in the modeling approach to estimate total areawide costs for different combinations of control options.

Option 3 is similar to option 2 in that the basic relationship used to estimate future emissions is simply:

Base Year Emissions * Growth Factor * Control Factor = Future Year Emissions

Option 3 is of value where retaining source-specific information is desirable. For many control strategy applications, this information may be essential. Having source-specific information is always preferable when control costs are to be estimated. It also allows one the opportunity to drop individual sources or plants from the data file if plant closures are planned. In addition, source sizes are beneficial when estimating the effect of applying controls down to a specific size cutoff. Finally, the requirement to use allowable emission rates in emission projections may make it necessary to retain source-specific information, unless source categories can be defined in a way that makes all allowable emission rates the same within a category. While retaining source-level data has its advantages, it also increases computation time (probably of little concern for urban-scale analyses) and forces an analyst to derive more complex routines for simulating new source growth at other than existing facilities or for modeling the new offset requirements for ozone nonattainment areas.

B. GROWTH AND RETIREMENT RELATIONSHIPS

Changes in stationary source activity levels are accounted for in the general projection modeling approach as represented by option 1 above, by a combination of growth and retirement rates. This is done because regulations affecting new sources differ from those affecting existing sources. Therefore, different control assumptions are identified for each. Growth rates and controls are applied to estimate new source emissions.

Retirement rates are applied to estimate how emissions from existing sources will decrease.

The most recent industry-by-industry projections of growth applicable to an air pollution analysis are those performed by the BEA (BEA, 1990a; 1990b; 1990c) and discussed in detail in Chapter III. These growth rates were calculated based on earnings and, therefore, are assumed to represent **net** growth for an industry. In other words, retirement of existing sources is taken into account. Retirement rates for existing sources are shown in Table V.1. These estimates of plant retirement rates were developed by Data Resources, Inc. (U.S. DOE, 1979) in support of an industrial sector technology model development effort.

Table V.2 presents retirement rates developed from Internal Revenue Service Depreciation Guidelines. Annual retirement rates for this table are estimated as the reciprocal of two times the depreciation period in years. As the average depreciation periods are on the order of 10 to 20 years, most of the annual retirements range from 2.5 to 5.0 percent per year. A choice between using the retirement rates in Table V.1 versus Table V.2 is probably best made by selecting the one with the categories that match best with the base year inventory being used.

The equation which should be used to incorporate the growth and retirement rate data in an emissions projection is as follows:

$$Q_n = Q_o \{[(1 + G_i)^t - 1] F_n + (1 - R_i)^t F_e + [1 - (1 - R_i)^t] F_n\} \qquad (1)$$

where:

Q_n	=	emissions in projection year
Q_o	=	emissions in base year
R_i	=	retirement rate
F_e	=	emission factor ratio for existing sources
G_i	=	growth rate
F_n	=	emission factor ratio for new sources

The first term in the equation represents new source growth and controls, the second term accounts for retirement and controls for existing sources, and the third term accounts for replacement source controls. It should be noted that the G_i term in equation (1) represents net growth. If a total growth rate (G'_i) is used, the first term in equation (1) should be changed to $[(1 + G'_i - R_i)^t - 1] F_n$.

Emission factor ratios are specified separately for new and existing sources because regulations affecting new sources can differ from those affecting existing sources. Therefore, different control assumptions are identified for each. Emission factor ratios for any projection year can be defined as the estimated average emission rate within a source category for that

Table V.1

Industrial Retirement Rates

Industry	SIC	Average Annual Retirement Rates (percentage per year)
Agricultural Production	01	4.26%
Agricultural Services	07	4.26%
Forestry	08	4.26%
Fishing, Hunting, and Trapping	09	4.26%
Metal Mining	10	4.26%
Anthracite Mining	11	4.26%
Bituminous Coal and Lignite Mining	12	4.26%
Oil and Gas Extraction	13	4.26%
Mining and Quarrying	14	4.26%
Building and Construction	15	4.26%
Construction Other than Buildings	16	4.26%
Construction - Special Trade	17	4.26%
Food and Kindred Products	20	4.56%
Tobacco	21	3.35%
Textile Mill Products	22	3.20%
Apparel	23	3.18%
Lumber and Wood Products	24	6.37%
Furniture and Fixtures	25	3.68%
Paper and Allied Products	28	5.07%
Printing and Publishing	27	4.92%
Chemicals and Allied Products	28	5.07%
Petroleum Refining	29	4.48%
Rubber and Miscellaneous Plastics	30	2.97%
Leather and Leather Products	31	4.09%
Stone, Clay, Glass and Concrete	32	4.93%
Primary Metal Industries	33	4.97%
Fabricated Metal Products	34	3.23%
Machinery, Except Electrical	35	4.10%
Electrical Machinery	36	4.61%
Transportation Equipment	37	4.09%
Miscellaneous Instruments	38	4.83%
Miscellaneous Manufacturing Industries	39	4.41%
Railroad Transportation	40	4.26%
Interurban Transit	41	4.26%
Motor Freight Transportation	42	4.26%
U.S. Postal Service	43	4.26%
Water Transportation	44	4.26%
Air Transportation	45	4.26%
Pipe Lines, Except Natural Gas	46	4.26%
Transportation Services	47	4.26%
Communication	48	4.26%
Electric, Gas and Sanitary Services	49	4.26%
General Government, Except Finance	91	4.26%
Justice, Public Order, and Safety	92	4.26%
Public Finance and Taxation	93	4.26%

SOURCE: U.S. Department of Energy, 1979.

Table V.2

Retirement Rates Developed From Internal Revenue Service Depreciation Guidelines

Source Types	Annual Retirement Rate
Exploration for & Production of Petroleum & Natural Gas Deposits & Storage	0.036
Natural Gas Production Plant	0.036
Liquified Natural Gas Plant (& Storage)	0.022
Petroleum Refining of Crude Petroleum	0.031
SOCMI	0.050
Manufacture of Vegetable Oils/Vegetable Products	0.028
Manufacture of Finished Plastic Parts	0.045
Manufacture of Basic Plastic Parts, Phonograph, Records, Motion Picture Films & Tapes, Pens, etc.	0.042
Manufacture of Rubber Products	0.036
Manufacture of Primary Steel Mill Products	0.033
Manufacture of Primary Nonferrous Metals	0.036
Manufacture of Electronic Components	0.083
Manufacture of Electrical & Non-Electrical Machines, and Other Mechanical Products	0.050
Manufacture of Tobacco & Tobacco Products	0.033
Manufacture of Other Food Products & Beverages	0.042
Manufacture of Leather & Products	0.045
Manufacture of Yarn, Thread, & Woven Fabric (Includes Tire Fabric & Ind. Belts)	0.045
Manufacture of Pulp & Paper	0.038
Manufacture of Converted Paper, Paperboard & Pulp Products (i.e., for bags, envelopes, etc.)	0.050
Manufacture of Glass Products	0.036
Manufacture of Stone & Clay Products	0.033
Mining Equipment for Sand, Gravel, and Minerals	0.050
Manufacture and Production of Substitute Natural Gas - Coal Gasification	0.028

Source Types	Annual Retirement Rate
Exploration for & Production of Petroleum & Natural Gas Deposits & Storage	0.036
Natural Gas Production Plant	0.036
Manufacture of Fabricated Metal Products (i.e., cans, tinwire, etc.)	0.042
Manufacture of Motor Vehicles	0.042
Manufacture of Wood Products & Furniture	0.050
Manufacture of Locomotives & Railroad Cars	0.042
Ship and Boat Building Machinery and Equipment	0.042
Manufacture of Aerospace Products	0.050
Graphic Arts Industry	0.045
Utility - Electric Steam Production Equipment	0.018
Industrial-Steam & Electric Generation Equipment	0.023
Electric Utility Combustion Turbine	0.025

Source: U. S. EPA, 1988

future year divided by the average emission rate for that same category in the base year. Emission factor ratios are also referred to in some references as control factors.

As part of the process in estimating how future year emissions might be different from base year emissions, it is important to consider the potential effects of technology changes on emission rates. Because a large fraction of organic emissions are from evaporation, control approaches can result in different product formulations, which in turn can produce dramatically different emission rates and reactivity profiles. Examples include the substitution of water-based for oil-based paints, new lower emitting less reactive solvents, and elimination of some high emitting products, such as cutback asphalt, in ozone nonattainment areas. The provisions in the CAAA that require nonattainment regulations for consumer or commercial product categories that account for at least 80 percent of the VOC emissions would be expected to trigger considerable new product development and reformulation. Therefore, it is important that the states track rulemaking efforts for these categories to establish how technology changes might affect future emission rates.

C. FUTURE DIRECTIONS -- EMISSION PREPROCESSOR SYSTEM (EPS) ENHANCEMENTS

EPA is in the process of upgrading the Emissions Preprocessor System (EPS) to provide a computerized tool for implementing the projection and control guidance in this document. The enhancements will allow for anthropogenic emissions to be projected and/or controlled on a county-level basis by source category. The projections will be accomplished by applying a growth factor to the base emissions. Controls and RE will be handled as control factors (also described as emission factor ratios earlier in this chapter), which are fractions less than or equal to one. Allowable emissions will be handled similarly, incorporating both growth and controls.

In addition, a utility is being added to EPS to aid the user in generating the growth factor input file based on BEA data. This utility will not generate the projection factors, but will create the projection factor input file from existing BEA growth factors by source category. Other enhancements should make EPS more flexible and easier to operate.

The revised version of EPS will be a menu-driven system based in FORTRAN, with the menu portion programmed with SAS. The new system should be available for distribution to the states by May of 1992.

VI VALIDATION

There are a number of methods that can be applied to validate **historical** emission estimates. Stack tests or continuous emission monitoring data can be used as a validation tool for stationary source emission estimates. Similarly, motor vehicle travel estimates can be validated by traffic counts on selected roadways. Validating **future year** emission estimates is more problematic, however.

It is recommended that, before state and local agencies submit their emission projections to EPA, that some validation, or reasonableness, checks be performed. These can be done for the complete inventory of sources, as well as for individual components such as highway vehicles. In short, the validation method being suggested is a comparison of projection results with those of other recently completed studies for the same or similar areas to identify and understand any inconsistencies.

One emission projection effort that may prove useful in validating SIP emission projections is that performed as part of the ROMNET study. The ROMNET inventory uses the 1985 National Acid Precipitation Assessment Program (NAPAP) Emissions Inventory as its source of base year operating and emissions data. The ROMNET modeling domain includes 12 full states and the District of Columbia, portions of another 7 states, and a portion of Ontario, Canada. The 12 full states included in the ROMNET study were: New Hampshire, Massachusetts, Rhode Island, Connecticut, Delaware, Virginia, West Virginia, New York, New Jersey, Pennsylvania, Maryland, and Ohio. The inventory has been subjected to additional quality assurance (QA) procedures and updates based on more current or accurate information gathered from the sources themselves, or provided by state agencies. ROMNET includes both baseline emission projections and strategy emission projections.

These inventories concentrate on the large point sources of NO_x and VOC inherent in the NAPAP plan and methodology. Emissions sources (plants) of less than 100 tpy are not included as point sources in the inventory. Individual points emitting less than 25 tpy are also not included. Sources of CO have undergone less rigorous QA. Area source categories (including mobile sources) are based on the NAPAP list of area source categories rather than the SIP categories. Both inventories use temporal allocation software developed for the 1985 NAPAP emissions inventory to derive seasonal, daily, and hourly allocation factors and generate similarly resolved emissions.

ROMNET projection inventories relied principally on BEA employment projections for approximately 90 2-digit SIC groups. Control scenarios have been simulated using these groupings rather than individual plant projections. Utility emissions were projected based on the Advanced Utility Simulation Model (AUSM) results. The states reviewed all growth projections and, in some cases, substituted their own data.

The Office of Technology Assessment (OTA) analyzed (1989) the VOC emissions reductions from a number of source-specific control strategies (1989), including the following, which are reasonably representative of the new measures mandated for ozone nonattainment areas in the CAAA.

- Adoption of RACT on all existing stationary sources for which a regulation already exists in any SIP.
- Adoption of new CTGs -- RACT-level controls for several existing stationary sources of VOC for which EPA has not issued control guidelines, and which have not previously been subject to regulation in any SIP.
- Emissions controls on hazardous waste TSDFs.
- Establishment of new Federally regulated controls on architectural surface coatings.
- Onboard vapor recovery systems on motor vehicles to capture gasoline vapor during refueling.
- Stage II control devices on gasoline pumps to capture gasoline vapor during motor vehicle refueling.
- Inspection and Maintenance (I/M) programs for highway vehicles.
- More stringent exhaust emission standards for gasoline highway vehicles.
- New Federal restrictions on gasoline volatility.
- The use of methanol instead of gasoline as a fuel for vehicles in centrally owned fleets in the worst nonattainment cities.

Compared with VOC emissions for a 1985 base year, by 1994, application of the measures outlined above was estimated to result in a 34 percent reduction, on average, of emissions in nonattainment cities. Because of uncertainty in the emissions inventory, differences in source category contributions by area, and the degree to which future emissions can be controlled, total emissions reductions from the measures analyzed ranged from 18 to 37 percent of 1985 levels. The percentage reductions for most categories are about the same in 1994 and 2004, except for onboard VRS controls and new highway vehicle standards, which increase because more of the older vehicles will have been replaced by newer, lower-emitting vehicles. Additional emissions reductions in 2004 from onboard VRS and other highway vehicle emission standards, as a percentage of total 1985 emissions, are estimated by OTA to be about 4 percent.

EPA-sponsored analyses (Pechan, 1991) of the CAAA have shown that ozone nonattainment areas that institute all of the measures required for areas in the severe and extreme categories can conceivably achieve VOC reductions of about 45 percent (as a percentage of 1987 emissions) by 1995, and close to 50 percent by 2000. While these emissions reductions are higher than those estimated by the OTA, the OTA figures do not include reductions that might be achieved from consumer/commercial product rules or from reformulated gasoline. Note that the Pechan analysis assumes that EPA will choose **not** to adopt Phase II or Tier II light-duty vehicle emissions standards. If adopted, these emissions standards would not provide emission benefits until **after** 2000, in any event.

VII CASE STUDIES

Two recently completed projection analyses for modeling studies provide some useful experience to those who may be unaccustomed to performing emission projections. The Southern California Association of Governments (SCAG) and the SCAQMD prepared baseline projections of activity and emissions for the South Coast Air Basin (SCAG, 1989, and SCAQMD, 1989). This information was used to prepare a grid based emission inventory for both current and future years. For areas planning to use a grid based model for their attainment demonstration, this example should assist in showing how this type of analysis can be performed. Because growth in the Los Angeles area is heavily affected by migration from outside the United States, there was more emphasis in the South Coast analysis on population projections than might otherwise be the case. This factor is probably less important in other nonattainment areas.

The ROMNET analysis (Possiel, 1991) was to support a regional modeling exercise, but it is expected that SIP analyses will be consistent with the level of detail of this analysis. Hence, it is a relevant example.

A. SOUTHERN CALIFORNIA EMISSION PROJECTIONS

Southern California based its emission projections on an analysis of population and employment through the year 2010. The region began with a draft baseline projection that was a calculation of what the population and employment growth of the SCAG region would be if the demographic and economic forces experienced over the previous decade were to continue through the year 2010. This baseline projection also reflected national and state-level projections of demographic and economic trends and, in a few cases, data which indicated that future trends were likely to diverge from historic trends. The baseline projection did not assume any government intervention with demographic, economic, or housing market trends.

1. Population Projections

There are three primary components of population growth: births, deaths, and net migration. The first two components constitute natural increase (births minus deaths), and the third, net migration, can be separated into net domestic migration (within the United States) and net foreign migration (people moving from other countries) which includes both legal and illegal immigrants.

The SCAG projection anticipated that natural increase will play a more dominant role in the region's growth than it has in the past. Between 1975 and 1980, half of the population growth was the result of natural increase. Between 2000 and 2010, natural increase is projected to contribute 75 percent of the region's total growth. This increase is attributable to the growing Hispanic population (with high fertility rates) and the decreasing ratio between migration and the region's population. Overall, natural increase represents 63 percent of the region's population growth between 1980 and 2010.

Migration includes both inward and outward movement. Net migration in the SCAG region was projected to be negative from 1980 to 2010. Net out migration is small relative to the total population of the region, however. Between 1980 and 2010, about 9.0 million people are expected to leave, while 8.1 million are projected to enter. This indicates a very mobile population.

Recent trends have shown high levels of immigration to the SCAG region. Potential reasons for this may include the following:

- Job opportunities relative to other areas
- Proximity to Mexico and Central America
- Pacific Rim location
- A similar climate to Latin American and Asian-Pacific countries
- Large ethnic communities and cultural centers already located in the region

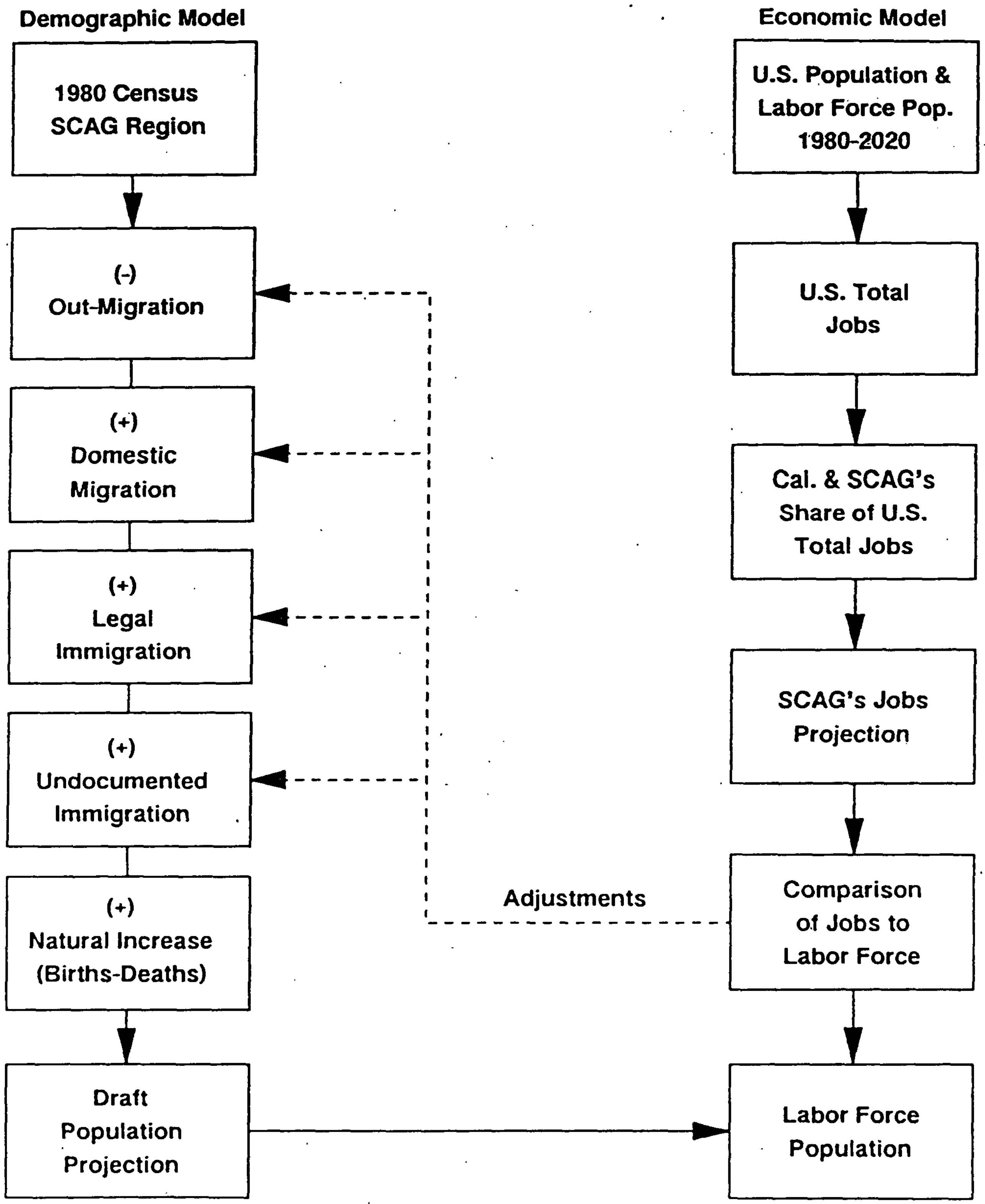
For both the nation and the SCAG region, the population will be aging. The changing age structure of the population was reflected in the SCAG baseline projection, with the median age of males increasing by 5.8 years and females by 6.4 years by 2010. Projected male versus female age differences will continue. This difference is primarily the result of higher female survival rates.

At the national level, the median age of males is projected to increase by eight years and the median age of females by nine years. The population of the SCAG region is expected to remain younger than the nation's population with the influx of immigrants who are typically young, and the relatively higher fertility rates of the Hispanic population.

The projection model used by the South Coast links economic data to population dynamics, and is based on the assumption that patterns of migration into and out of a region are influenced by labor market variables. The demographic projections, following a cohort-component procedure, are developed independently from the economically driven projections. Results of the demographic model are then compared with those of the economic projections and the migration assumptions are adjusted as a function of projected employment. Figure VII.1 illustrates the relationship between the demographic and economic projections.

SCAG's baseline employment projection model is based on a detailed shift/share analysis of industries in the Los Angeles

Figure VII.1
Relationship Between SCAG Demographic and Economic Projections



basin compared with State and national projections for those industries. A flow chart of the major components of the modeling process is shown in Figure VII.2.

As Figure VII.2 shows, the model begins with national job projections prepared by the BLS Office of Economic Growth. This includes detailed industry-by-industry projections of employment and output for 155 sectors of the U.S. economy. From the national projections, the model derives California's and the region's share of national growth. To perform the **sharing analyses**, industries are divided into base and nonbase, where base industries are those with national, international or state markets (e.g., manufacturing) and nonbase are those dependent on demand from local markets (i.e., population serving).

The state model used 83 sectors for California's share of the U.S. economy, with 66 base and 17 nonbase industries. The regional model used 66 industries because the regional economy is less broad than the state economy (and ends up with 49 base and 17 nonbase industries). Table VII.1 shows the list of base and nonbase industries used in the SCAG analysis.

Regional projections were needed for each of the individual base industries. Historical annual wage and salary employment data were used from the Employment Development Department. The model uses these data to examine the following:

- Each industry's 1984 share of employment in the state
- The industry's historical average share of employment over the last 12 years
- Its share of total job growth over the same period
- Changes in the industry's share of employment over time

For each industry, a share factor was selected from one of the above indicators. These share factors were then applied to the projected state growth levels in each of the base industries to yield an estimate of total growth in the base industries for the region for a projection year.

Nonbase industry jobs were projected based on the historical relationship between base jobs and total jobs. This job multiplier is used with the total base employment figure for the projection year to estimate total employment. The difference between projected total jobs and projected base industry jobs is total nonbase industry jobs.

Total nonbase industry jobs then had to be allocated to the individual categories shown in Table VII.1. The model did this by calculating the ratio of the share of each nonbase industry to total jobs in the SCAG region compared with that industry's state share of the state's total jobs. The ratio was then used as a weighting factor to adjust statewide nonbase shares to reflect regional shares.

Figure VII.2
SCAG Economic Projection Model

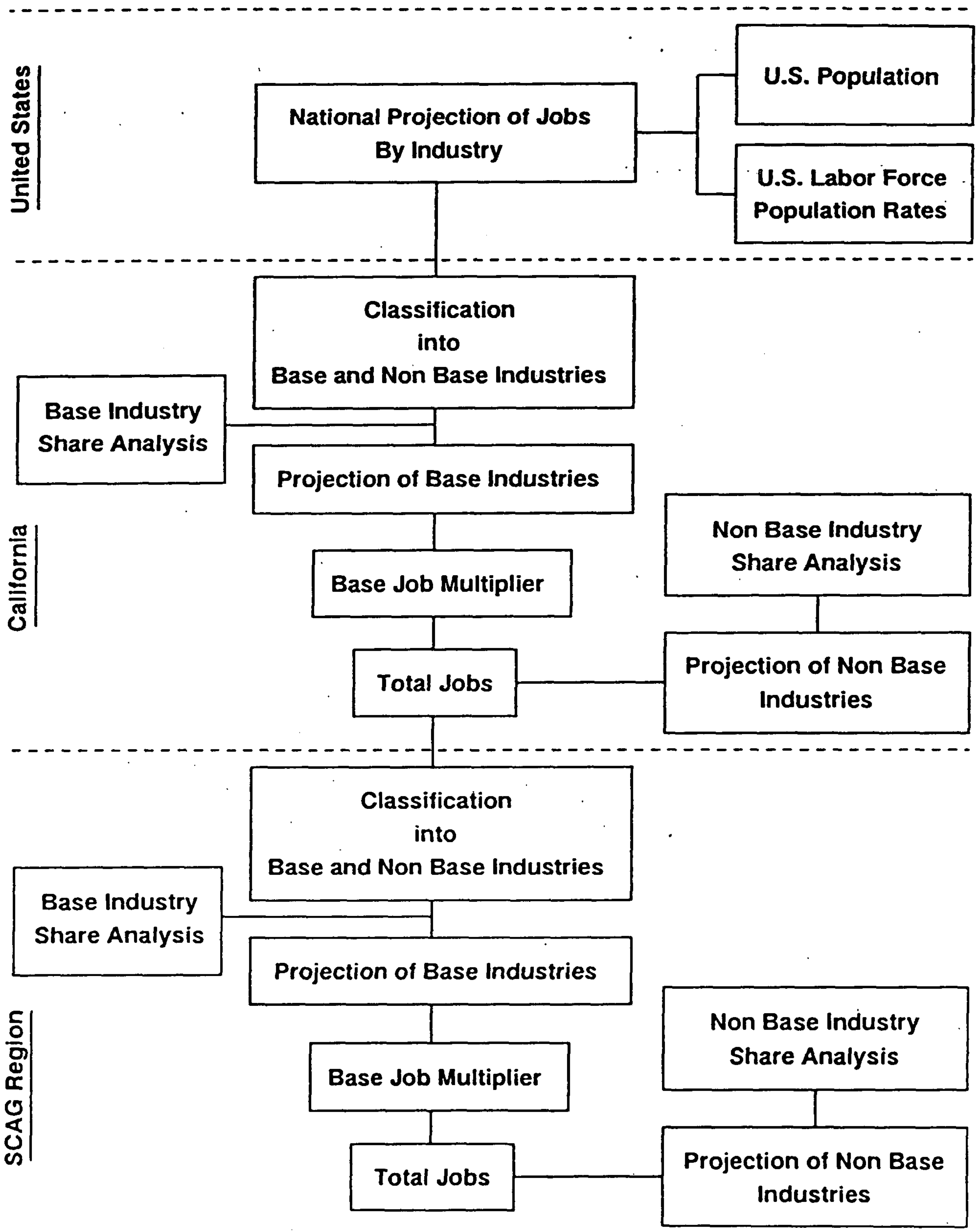


Table VII.1

Base and Nonbase Industries for the SCAG Region

NONBASE

Self-Employed & Household Workers	Personal Services
Construction	Repair Services
Local Transit	Theaters
Travel Services	Medical Services
Communications	Legal Services
Utilities	Educational Services
Retail Trade	Nonprofit Organizations
Finance	Professional Services
Insurance	Local Government
Real Estate	Local Education

BASE

High Technology

Computers
Communication Equipment
Electronic Components
Measure Control Instruments
Medical
Other Instruments
Computer Service

Diversified Manufacturing

Other Food Products
Textiles
Apparel
Other Lumber & Wood Products
Furniture
Paper Products
Printing
Chemicals
Rubber, Plastic Products
Leather
Stone, Clay, Glass
Primary Metal Products
Fabricated Metal Products
Machinery (except computers)
Machinery (except communications equip. and electronic components)
Motor Vehicles
Misc. Transportation Equipment
Misc. Manufacturing

Defense Oriented

Aircraft
Ship Building and Repair
Missiles, Space
Department of Defense

Resource Based

Agriculture
Mining
Canned, Frozen Food
Logging
Petroleum Products

Basic Transportation

Railroads
Truck Transportation
Water Transportation
Air Transportation
Pipeline Transportation

Other Basic

Wholesale Trade-Durable
Wholesale Trade Nondurable
Hotels
Motion Picture (filming and distribution)
Amusements
Other Business Services
Agricultural Services
Federal Civilian
State Government
State Education

A key component relating employment and population projections is the civilian labor force. The civilian labor force is the number of noninstitutionalized or nonmilitary personnel 16 years old or older who are working or actively seeking work. The civilian labor force can be determined in two ways. One is from an employment projection and the other is through the labor force participation rates of the demographic mix in the area.

2. Baseline Emission Projections

a. Stationary Sources

The next step in the SCAG region projection effort was to estimate future baseline emissions. Baseline emissions in this case were defined as those expected if no additional air quality regulations are introduced. These emissions are forecasted using control measures in effect at the time of the projection, and growth rates for population, industry, and motor vehicle activity. For the SCAG region study, growth rates were as determined using the techniques described in the preceding section.

Future year baseline emissions are estimated for each individual source category using the relationship shown in the equation below:

$$Emis_{FY} = Emis_{Base}\,(CF)(GF) \qquad (1)$$

where:

$Emis_{FY}$ = future year emissions
$Emis_{Base}$ = base year emissions
CF = control factor (the level of control imposed on a single source category as a result of existing state and local air quality regulations)
GF = growth factor from SCAG regional modeling

Control factors for selected stationary source categories for the SCAG region are illustrated in Table VII.2. Control factors are shown for total organic gases, oxides of nitrogen, and sulfur oxides. Similarly, examples of growth factors for the counties in the SCAG region are shown in Table VII.3.

b. Mobile Sources

Within the SCAQMD, mobile sources consist of two subcategories: on-road and off-road sources. On-road vehicle emissions are calculated using socio-economic data provided by SCAG, spatial distribution data from Caltrans' Direct Travel Impact Model (DTIM), and emission factors from the California Air Resources Board's motor vehicle emission factor model, EMFAC7. Emissions from off-road vehicle categories (e.g., trains, ships, utility engines) were calculated as area sources.

Table VII.2

Stationary Source SCAG Region Control Factors
For the Years 2000 and 2010*

CONTROL CODE	CONTROL NAME	CONTROL FACTORS TOG	NO_x	SO_x
104	Residential Space Heaters	-	0.78	-
105	Residential Water Heaters	-	0.57	-
107	Non-Utility I.C. Engines: Gas	-	0.33	-
110	Cement Kilns	-	0.74	-
111	Glass Melting Furnaces	-	0.50	-
114	Sulfur in Fuel	-	-	0.80
117	Refinery Boilers and Heaters	-	0.64	-
124	Utility Turbines: Gas	-	1.00	-
301	Architectural Coatings: Oil Based	0.53	-	
302	Architectural Coatings: Water Based	0.53	-	-
303	Architectural Coatings: Solvent	0.53	-	-
308	Metal Parts & Products: Surface Coating	0.85	-	-
309	Metal Parts & Products: Solvent	0.85	-	-
316	Cut-Back Asphalt Paving Material	0.67	-	-

* Control categories not listed in this table have control factors equal to one.

Table VII.3

SCAG Region SIC Code Growth Factors for The Year 2000

SECTOR	SIC CODE	LOS ANGELES COUNTY	ORANGE COUNTY	RIVERSIDE COUNTY	SAN BERNARDINO COUNTY
Agriculture	01-09	1.056	1.057	1.030	1.043
Mining	10-14	0.992	0.976	1.000	1.000
Construction	15-19	1.107	1.509	2.651	1.844
Manufacture	20-39	1.133	1.352	1.159	1.226
Trans. Util.	40-49	1.195	1.812	1.770	1.865
Retail	52-59	1.228	1.527	2.027	1.853
Wholesale	50-51	1.179	1.808	1.463	1.647
Fin-Ins-Re	60-69	1.269	1.621	1.938	1.682
Services	70-89	1.507	2.007	2.358	2.052
Government	90-97	1.073	1.178	1.466	1.427
Self Employ	——	1.008	1.562	1.429	1.382
Employ-NRet	52-59	1.231	1.596	1.670	1.605
Serv.-Inst	50-97	1.302	1.675	1.893	1.775
Population	——	1.134	1.359	2.151	1.803
Housing Un.	——	1.183	1.429	2.242	1.847
Food	20	0.966	0.661	0.298	1.306
Apparel	23	0.944	0.557	1.060	1.060
Furniture	25	1.370	1.983	3.199	1.723
Paper	26	0.964	0.955	0.698	0.980
Printing	27	1.244	1.790	1.651	1.842
Chemicals	28	1.171	1.375	1.060	0.964
Petroleum	29	1.046	1.130	1.130	1.130
Rubber & Plas	30	1.1988	1.435	1.504	1.294
S.C & G	32	1.086	1.063	1.000	1.154
Pri.Metals	33	1.032	0.993	1.008	1.356
Fab.Metals	34	1.136	1.394	1.606	1.356
Mach-NElect	35	1.172	1.482	1.731	1.176
Elect.Equip	36	1.383	1.488	1.799	1.487

Trans Equip	37	1.003	1.097	0.672	1.265
Aircraft	372	1.132	1.137	1.140	1.145
Instrument	38	1.088	1.368	1.441	1.286
Other Mfg.	21,2 4,31,9	1.000	1.049	0.880	0.723

NOTE: These growth factors are relative to 1984 base year.

EMFAC is the California ARB's model for estimating emission factors for on-road motor vehicles. Originally, EMFAC closely paralleled EPA's model, MOBILE, with the exception of its different treatment of trip end emissions. As the California-specific vehicle emission data base grew, the model has become an independent entity as needed to reflect California's motor vehicle fleet.

The emission factors generated by EMFAC are used in conjunction with activity data in BURDEN to develop the motor vehicle emission inventory. BURDEN is a county-specific program that uses vehicle activity from either local travel demand models or the California Department of Transportation's statewide travel model activity disaggregated to the county level.

The above calculation allowed the SCAQMD to compute total baseline emissions of criteria air pollutants as well as the relative contributions by stationary and mobile sources. To determine the spatial distribution of population and emissions, the Air Basin was divided into a grid system composed of 5 km by 5 km grid cells and the emissions were allocated to these grid cells.

c. Summary

Table VII.4 summarizes the key resulting socioeconomic parameters used in the emission forecasts for 2000 and 2010 in the region.

South Coast Air Basin baseline emission projections (accounting for regulations adopted as of June 1990) show that organics, NO_x, SO_x, and PM_{10} are not expected to decrease appreciably between 1987 and 2010 (SCAQMD, 1991). This is a result of regional growth in population, housing, and motor vehicle use. Baseline CO emission projections showed a 50 percent expected decline by 2010.

Significant differences in the spatial distributions of net changes in emissions of VOC, NO_x, and CO between 1987 and 2010 were predicted within the air basin. VOC, NO_x, and CO emissions are expected to decrease significantly in the western part of the basin, but are predicted to increase in the east. This underscores the importance of accurately assessing spatial changes in emissions when emission projections are to be input to a grid-based model.

Once the SCAQMD computes their expected baseline emissions for 2000 or 2010, they apply additional control measures, which they have divided into three tiers, depending on their readiness for implementation. Thus, for any individual proposed rule not included in the baseline emissions calculation, the associated emission reduction, or control factor, is estimated with reference to the future year baseline. The effects of individual measures in reducing criteria pollutant emissions are too

Table VII.4

Baseline Socioeconomic Forecasts for the South Coast Air Basin*

Socioeconomic Category	1987	Year 2000	(% Growth)	Year 2010	(% Growth)
Population (Millions)	12.0	14.3	(+19)	15.7	(+31)
Housing Units (Millions)	4.4	5.5	(+25)	6.1	(+39)
Total Employment (Millions)	6.0	7.4	(+22)	8.2	(+36)
VMT (Million Miles)	240.1	323.5	(+35)	387.6	(+62)
In-Use Vehicles (Millions)	7.9	9.2	(+17)	10.3	(+31)
Vehicle Trips (Millions)	29.2	35.3	(+21)	40.0	(+37)

* No AQMP measures included.

SOURCE: SCAQMD, 1991.

voluminous to list in this example. Readers interested in more details are referred to the SCAQMD (1991) report. The net result of applying the three tiers of control measures in the South Coast is a significant additional reduction in expected criteria pollutant emissions from the baseline emission levels estimated for 2010. Estimated annual average ton per day emission reductions from the 2010 baseline for the SCAB are as follows:

Organics	83%
NO_x	62
CO	51

Note that because of the severity of the air pollution problem in the South Coast Air Basin, that the reduction percentages listed above are considerably higher than what is expected to be achieved in a typical nonattainment area.

B. REGIONAL OZONE MODELING FOR NORTHEAST TRANSPORT -- PROJECTION YEAR AND CONTROL STRATEGY EMISSIONS INVENTORIES

EPA's ROMNET program was undertaken to quantify the concentrations of ozone and ozone precursors transported among urban areas in the Northeast, and to assess strategies for attaining the ozone National Ambient Air Quality Standard (NAAQS). Inventory development for ROMNET was overseen by an Emissions Committee and a Strategies Committee, each of which included representatives from the states in the region.

In the projection phase of ROMNET, emissions were estimated for the year 2005 under a number of different emissions control scenarios. This section focuses on the methodologies used to predict future emissions. The ROMNET final report gives additional details on the emission control strategies analyzed, and the magnitudes of predicted emissions (Possiel et al., 1991).

1. Inventory Structure

For each future emission scenario, a detailed emissions inventory was prepared to serve as input to the Regional Oxidant Model (ROM). Each ROMNET inventory contains anthropogenic emissions data for total hydrocarbons (THC), volatile organic compounds (VOC), nitrogen oxides (NO_x), and carbon monoxide (CO), which are precursors in urban ozone formation. NO_x emissions are divided into NO and NO_2; and organic emissions are broken into 11 reactivity classes based on the Carbon Bond IV system.

All of the ROMNET future emissions inventories derive from the 1985 ROMNET emissions inventory (Battye, 1989), which in turn was based largely on the 1985 NAPAP emissions data base (Saeger, 1989).

Each ROMNET inventory contains separate files for point sources, stationary area sources, and mobile sources. The distinction between point and area sources is the same as that used in NEDS (plant emissions of 100 tons or more per year of any criteria pollutant, or 5 tons per year of lead).

The area source inventory does not address individual sources, but instead gives emissions for aggregated groups of sources that are too small or numerous to be covered by the point source inventory. Area sources in the ROMNET inventory include minor fuel combustion sources; open burning and solid waste disposal; structural and forest fires; nonhighway transportation sources such as trains, airplanes and off-highway vehicles; solvent evaporation from paints and other solvent uses; and some industrial fugitive emissions and process vent emissions. The mobile source inventory includes only highway vehicle emissions.

Emissions are apportioned into a Mercator grid system, with each grid square covering one-sixth of a degree latitude and one-fourth of a degree longitude (or an area roughly 20 km by 20 km). Each inventory gives hourly emissions for three day-types: typical weekday, Saturday, and Sunday. Data in the point and area source inventories reflect emissions on clear hot summer days, which characterize a typical episode with exceedances of the ozone NAAQS.

2. <u>Projection and Control Algorithms for Point and Area Sources</u>

Table VII.5 depicts the basic algorithm used in ROMNET for determining future point and area source emissions. The algorithm is somewhat more complicated if NSPS apply, since these standards affect only new, modified and reconstructed emissions sources.

The algorithm in Table VII.5 is implemented at the finest level of detail allowed by the point and area source inventories. In the point source inventory, growth and control factors were applied to each individual source. For area sources, the factors were applied at the county and emissions category level. In this way, growth in an emission category was spread equally among all of the individual sources in the category.

Growth rates used in the projection algorithm vary by state and also for different industrial categories within each state. The growth rate represents an increase or decrease in the basic activity that causes emissions. In general, each point source and each industrial area source category was assigned a growth rate based on its 2-digit SIC code. For utilities and industrial cogeneration, growth factors were applied on a more detailed level, based on the fuel burned and the combustion method. Future emissions from nonindustrial area sources were projected based on population growth.

Table VII.5

Equations Used to Predict Future Point and Area Source Emissions

E_{2005}	=	$E_{1985} \times GF \times (100 - Eff_{2005}) / (100 - Eff_{1985})$	(1)
GF	=	$(1 + r/100)^{20}$	(2)

Variable definitions:

E_{2005}	=	estimated emissions in 2005 (tons/year)
E_{1985}	=	emissions in 1985 (tons/year)
GF	=	growth factor from 1985 to 2005 in the activity causing emissions (dimensionless)
r	=	growth rate (percent per year)
Eff_{2005}	=	control efficiency for the 2005 inventory (percent)
Eff_{1985}	=	control efficiency in the initial 1985 inventory (percent)

ROMNET control strategy efficiencies can be applied for the entire region, for the Northeast Corridor, or at the state, MSA, or county level. The degree of spatial resolution depended on the specific control scenario.

Emissions sources in the point source inventory were grouped into approximately 90 different source groups, or "pods," for the purpose of applying controls. ROMNET strategy efficiencies and existing control efficiencies were defined at the pod level within the appropriate geographic area. The ROMNET area source inventory was divided into 64 separate categories, derived from the 109 NAPAP and NEDS categories but excluding highway vehicles (which were treated separately from other area sources) and particulate emissions categories. Each area source category was treated separately for the purpose of applying controls.

3. Projection and Control Algorithms for Mobile Sources

Table VII.6 illustrates the general algorithm used to predict future mobile source emissions. Because of the temperature sensitivity of mobile source emissions, the mobile projection algorithm was designed so that day-specific inventories can be generated to reflect temperatures at the grid level.

The projection algorithm begins with 1985 emissions (E_{1985}^{noIM}), evaluated at a standard temperature (mean temperature = 85°F; diurnal variation = 20°F), and neglecting any local I/M programs. Predicted state-specific growth rates for VMT are applied to give "uncontrolled" emissions for 2005 (U_{2005}), keeping per-mile emission factors at their 1985 levels.

Two control factors are then applied to give 2005 emissions for a given ROMNET strategy. The first control factor includes regional controls such as the Federal Motor Vehicle Control Program (FMVCP) and regional reductions in RVP. Grid-level temperature adjustments are also made in this step. The second control factor is applied at the county level and accounts for local control measures such a I/M programs.

Emissions are projected at the grid and county level for VOC, NO_x, CO, and VOC and NO_x species. For VOC, separate projections are made for evaporative VOC emissions, VOC from gasoline exhaust and diesel VOC emissions. The segregation of VOC allows a final recalculation of VOC speciation to account for temperature variations and differential control efficiencies. The final speciation is day-specific and also varies from grid to grid depending on grid-level daily temperature profiles.

4. Summary of Future Scenarios

Fourteen inventories for future anthropogenic emissions were produced under ROMNET. All of these inventories represent emission scenarios for the year 2005. Two are projection

Table VII.6

Equations Used to Predict Future Mobile Source Emissions

$$U_{2005} = E^{noIM1985} \times (1 + r/100)^{20}$$

$$C_{2005} = U_{2005} \times CF_{reg} \times CF_{local}$$

$$CF_{reg} = EF_{str}/EF_{1985}$$

$$CF_{local} = (1 - Eff_{local}/100)$$

Variable definitions:

U_{2005}	=	projected emissions in 2005 at standard temperature (mean temperature = 85°F; diurnal variation = 20°F), neglecting local inspection and maintenance (I/M) programs and assuming that emissions remain at 1985 levels on a per-mile basis
$E^{noIM1985}$	=	1985 emissions at standard temperature and neglecting I/M
r	=	growth rate in vehicle miles traveled (percent per year)
C_{2005}	=	projected controlled emissions in 2005, adjusted for grid-level temperatures
CF_{reg}	=	regional control factor
CF_{local}	=	local control factor
EF_{str}	=	predicted 2005 emission factor for a given strategy, incorporating regionwide controls (temperature-dependent, in g/mile)
EF_{1985}	=	1985 emission factor used to develop $E^{noIM1985}$ (g/mile)
Eff_{local}	=	efficiency for any local controls that are applied above and beyond regional controls (percent)

inventories using different baseline control assumptions, and the remaining 12 represent various control strategies. The inventory development effort was carried out in two main phases. In Phase I, VOC controls were applied to different portions of the ROMNET region, while NO_x emissions were held constant. In Phase II, the relative impacts of VOC and NO_x controls were analyzed, as well as strategies for reducing VOC reactivity.

All of these inventories are in the same format as the base year inventory, with emissions given on a gridded, hourly basis for a typical summer weekday, Saturday, and Sunday. Emissions are given for VOC, NO_x, and NO_2. For mobile sources, tabular emission factors were prepared for each future inventory, providing the capability to adjust emissions to reflect grid- and day-specific temperatures.

Each of the future anthropogenic inventories was merged with a biogenic emissions inventory and input to the Regional Oxidant Model. The purpose of the modeling effort was to estimate ozone levels that would be observed under the various future emissions scenarios.

VIII BIOGENIC EMISSIONS PROJECTIONS

Recent modeling studies show the importance of including natural hydrocarbon emissions in ozone modeling studies. To produce these estimates, EPA developed a personal computer-based Biogenic Emissions Inventory System (BEIS) (Pierce, 1991). [This program is available from the EPA CHIEF Bulletin Board, which can be accessed through a personal computer and modem at (919) 541-5742.] The system calculates emissions at the county level using episode-specific data on temperature and sunlight intensity.

In BEIS, biogenic emissions are calculated from a set of emission factors and meteorological correction factors that are specific to various categories of land use or biomass. The general algorithm for nonforested areas can be summarized as follows:

$$ER = \sum_j (A_j * EF_j * F_j[S,T])$$

where ER is the total biogenic emission rate (grams/hour) for a given VOC species in a given grid, $\sum_j$ reflects the summation over all land use types, A_j is the area (square meters) of land use j in the grid, EF_j is the emission factor (g/m^2-hour) for land use j, and $F_j[S,T]$ is a dimensionless meteorological correction parameter that is a function of temperature and sunlight intensity.

The emission rate for forested areas is as follows:

$$ER_j = \sum_j (A_j * BF_j * EF_j * F_j[S,T])$$

where the new term BF_j is the mass of dry leaf in a given forested area (g/m^2). All other terms are the same as is the first equation, except that the emission factor EF_j is expressed in terms of emissions-per-leaf biomass (ug/g).

BEIS includes emission factors for 16 land uses: oak forest, other deciduous forest, coniferous forest, corn, peanuts/rice, tobacco, grass/pasture, hay/scrub/rangeland, potato, sorghum, alfalfa, barley/cotton/oats/rye, wheat, soybeans, urban areas, and water or barren land. Emissions are highest for forested land and corn (3-4 mg/m^2-hr). Emissions from foliage and grass in a typical urbanized area are about a factor of four lower (0.8 mg/m^2-hr), and emissions from crops other than corn are lower still (0.02-0.5 mg/m^2-hr).

The adjustment parameters ($F_j[S,T]$) are fixed for a given set of meteorological inputs, which are dependent on the episode being modeled. Also, the emission factor for a given land use (EF_j) is fixed. Therefore, land use area (A_j) is the only parameter that can be affected in an emission projection analysis.

A detailed projection of biogenic emissions for a growing metropolis would be expected to show a reduction in biomass corresponding to increased urbanization. This would result in a decrease in biogenic emissions. Biogenic emissions estimates are very uncertain, however, and projections of these emissions would be more uncertain. Biogenics, therefore, are held constant for most projection analyses.

There are several reasons for the uncertainty in biogenic emissions estimates. Both the emission factors and the meteorological correction factors are uncertain. In addition, the timing of biogenic emissions (between morning and afternoon) is not fully understood. The timing of emissions can be very important to grid modeling studies. Finally, up-to-date land use data are not readily available. BEIS uses county-level land use data extracted from the Oak Ridge National Laboratory's GEOECOLOGY data base, which was developed between 1970 and 1980 (Olson et al., 1980). Despite these limitations, BEIS represents the state of the art for quantifying biogenic emissions. Because of the importance of biogenic emissions, BEIS should be used to incorporate these emissions in air quality modeling exercises.

Projections of land use changes for biogenic emission calculations are not generally recommended, however. Some such projections may be desirable where dramatic changes in land use are forecasted. For example, the clearing of forested land to produce a reservoir could reduce biogenic emissions by up to 25 lb/hr/square mile. BEIS includes an option that allows the use of grid or county-specific land use areas. Predictions of land use changes can be obtained from local and state planning agencies.

IX QUALITY ASSURANCE PROCEDURES

A. INTRODUCTION

1. Definition of Quality Assurance

Quality assurance (QA) and quality control (QC) have been defined and interpreted in many ways. EPA's Quality Assurance Handbook (U.S. EPA, 1984) differentiates between the two terms by stating that quality control is "the operational techniques and the activities which sustain a quality of product or service," whereas quality assurance is "all those planned or systematic actions necessary to provide adequate confidence that a product or service will satisfy given needs." Quality control may also be understood as "internal quality control," namely, routine checks included in normal internal procedures (e.g., periodic calibrations, duplicate checks, split samples). Quality assurance may be viewed as "external quality control," or those activities that are performed on a more occasional basis, usually by a person outside the normal routine operations (e.g., on-site system surveys, independent performance audits). For the purposes of this document, QA is used collectively to include all of the above meanings of both quality assurance and quality control.

Other documents pertaining to SIP development QA have been issued by the EPA (U.S. EPA, 1988 and 1989). An additional document on quality review guidelines will be issued in July 1991. Prior to finalizing projection inventory QA procedures, an agency should consult and coordinate QA activities on the baseline inventory.

2. Purpose of Quality Assurance

Implementation of QA procedures is important for ensuring that results are of known data quality and are of adequate quality for the technical decision to be made. It is therefore important to define and understand the limits of the data to be used. This document deals with the development of data which will be utilized to develop and implement control strategies that must be effective in bringing an area into compliance with the NAAQS. Information used in this phase of the SIP development should be as accurate as possible to ensure that the control strategies will be effective. Errors can be introduced during the analysis, but the implementation of QA procedures can help to identify and reduce the impact of these errors. This document outlines procedures that can be used to uncover potential errors in the development of projection inventories. The procedures outlined below include the following steps and methods to fix them.

B. DESCRIPTION OF TASKS

1. Types of QA Procedures

There are several procedures that should be employed during the development of projection year inventories. These procedures can be broken down into the following categories: manual review, computer-assisted review, development and use of QA checklists, understanding chain of custody, and implementation of audits.

Manual review should be limited to those activities that can not be automated. This includes consistency checks from one system to another, such as checking the growth factors utilized to ensure consistency with other growth factors that may be available. These other growth factors may not be suitable for use in this application (due to limited source category coverage or data format incompatibilities), but they can be manually reviewed to ensure that the general growth assumptions are consistent. Manual review also includes procedures requiring intellect. This includes understanding and making decisions regarding the reasonableness of the results.

Computerized checks can be developed to fully utilize the strength of a computer to perform repetitious tasks. Whenever a QA procedure is found to be repetitious, examination of the procedure often uncovers a way that the computer can be introduced to perform the work. Examples include checks for missing data, correct units, and "reasonableness" (whether the value is within a "reasonable" range). The software developed for emission inventory projections should include many of these computerized checks. If the computer is utilized to develop preliminary input files, however, QA procedures should be developed and applied. An example would include the use of spreadsheet software to develop input files. If possible, macros should be developed that check on the accuracy or suitability of numbers prior to their use in the projection software. In addition, sums of values should be developed for checking against the projection software files. This will serve to uncover such problems as data translation errors and data format problems.

Checklists are developed and utilized to ensure that procedures designed and discussed throughout this document are implemented, and that results of these QA procedures are utilized to enhance the credibility of the analysis. An example QA checklist is provided in Appendix B.

Chain of custody is a procedure for preserving the integrity of a sample or of data (e.g., a written record listing the location of the sample/data at all times). Although no sampling data are involved in the projection inventories, similar procedures are developed to guard against the introduction of errors during conversion or transfer of data. This includes data integrity checks when data are transferred from one individual or organization to another.

Audits serve to introduce an unbiased person or group into the QA process. For the purposes of projection inventories, audits may only be necessary if the agency developing the SIP uses a method or a data set that is not consistent with the EPA guidance. Most agencies lack the resources necessary to use methods or data that are not provided in the EPA guidance. In the event that the agency does use alternatives, EPA may audit the material to ensure that it is consistent with EPA policies.

2. Program Elements Requiring QA

There are at least four program elements identified for the development of the projection inventories. These are planning, data collection, data analysis, and data presentation. As discussed below, QA should be included in all these elements.

Implementation of QA procedures should begin in the planning phase. The planning phase will identify the SIP development participants and their responsibilities. During the planning phase, the agency should set aside the time and resources necessary to conduct adequate QA. Time should be built into the schedule to allow for the QA, as well as for the correction of errors that are found. Resources include manpower (necessary to conduct manual review), computer resources (including the machine and personnel to program the computer), or dollars to purchase contractor assistance or alternative data sources.

Several QA procedures can be used during the data collection phase. This includes checks to ensure data quality and reliability. During earlier sections of this report, several sources of input data (specifically growth factors) were presented. Each of these sources has a different level of suitability. Included in the suitability determination is an understanding of the data quality and reliability as well as format, ease of use, and cost. Data quality must be understood prior to the use of the data. Collection of appropriate data is often a resource-intensive effort; therefore, priorities must be established for collection and QA of data. These priorities are often based on the sources' emissions magnitude. Other components may influence priority including which source categories are included in the control strategy, ballpark costs of individual controls, and the pollutant species being emitted. If the pollutant being controlled is also a toxic compound, additional QA resources may be warranted to ensure high quality data.

Data analysis encompasses the procedures and algorithms used to determine the answer to the initial question (namely, which control strategies will work given this projection scenario to allow for attainment of the NAAQS). Errors can be introduced during any phase of the data analysis. To minimize the introduction of errors, several facets of QA can be employed --

data validation, computational checks, reasonableness of results, and interpretation of results.

Data validation includes procedures for checking against miscoding data or misusing data. This would include errors introduced during the conversion of units or translation from one system or format to another and transfer from one group or individual to another. In addition, the data may have internal limitations. For example, the data may have been developed for a purpose that might preclude their use in this application. One may still choose to use the data, but the limitations it prsents should be recognized and documented.

Computational checks are often developed during the software development phase. Additional computational checks can be made at any time, however. These include comparison of different data fields to ensure consistency. For example, a growth factor applied to one source category may need to complement another category. If population is expected to increase in an area, there should be a corresponding growth in VMT and industrial activity. (A problem may exist if, during the QA process, population growth was forecasted without considering industrial growth.)

Reasonableness of results requires judgement on the part of the analyst to ensure that the results are logical. If the results are not sensible, research should be conducted until the analyst is comfortable with the findings and feels confident that any anomalies can be explained. In the example presented above, population could grow and industrial activity could decline if another type of change could explain the cause of growth. This might hold true in an area experiencing growth in the tourist industry or in the services industry.

QA should be introduced during the interpretation of results. When conclusions are drawn from the data and analyses, independent review should be performed to ensure that the results do indeed support the conclusion. The results should not be overanalyzed. This goes hand-in-hand with the initial purpose of employing QA procedures: to ensure adequate quality of information for the data upon which the technical decision to be made is based.

Finally, the presentation of results can result in errors or ambiguities. Data translation procedures should again be checked at this stage. This includes preparation of graphical displays of the data. Here unit measurements should be double-checked, and appropriate headings and legends should be created to ensure that the data are accurately presented. Again, results must be **reasonable**, and all data presentation should strive for interpretability.

X DOCUMENTATION

Documentation requirements for emissions projections will be consistent with those presented in the documentation chapters of Emission Inventory Requirements For Ozone State Implementation Plans (U.S. EPA, 1991c) and Emission Inventory Requirements For Carbon Monoxide State Implementation Plans (U.S. EPA, 1991d) for the base year emission inventories. In addition to the documentation requirements identified for the base year emission inventory, for projections it will be imperative to document the explicit control technique and control effectiveness values used in both the base year and future year emission estimates. Expected changes in activity levels will have to be documented as well.

For highway vehicles, an example of the level of detail of required documentation can be found in the Sec. 187 VMT Projection Guidance. It is especially important to detail the analyses used to estimate changes in vehicle speeds.

When future year emission estimates are completed, they will have to be submitted to EPA in a form compatible with the Aerometric Information Retrieval System (AIRS). Specific requirements will be described in the Reasonable Further Progress/Emission Tracking Guidance document scheduled for release in November 1992.

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APPENDIX A

PROJECTED ELECTRIC GENERATING UNIT ADDITIONS
(U.S. DOE, 1990)

Table 21. Projected Electric Generating Unit Additions, by State, Company, and Plant, 1990-1999, as of December 31, 1989

State Company Plant (County)	Unit ID	Scheduled Completion Date Current/Original	Generator Nameplate Capacity	Summer Capability (megawatts)	Unit Type[1]	Energy Source[1]	Unit Status
Alabama							
Alabama Electric Coop Inc							
Future Fossil (UNKNOWN)	1	Jun 98/Jun 95	125.0	125.0	ST	LIG	PL
McIntosh-CAES (Washington)	1	Jun 91/Jun 93	110.0	89.7	[2] GT	Nat Gas	CO
	2	Jun 96/Jun 94	110.0	89.7	[2] GT	Nat Gas	PL
McWilliams (Covington)	CT1	Jun 98/Jun 93	75.0	61.7	GT	Nat Gas	PL
	CT2	Jun 98/Jun 94	75.0	61.7	GT	Nat Gas	PL
	CT3	Jun 99/Jun 99	75.0	61.7	GT	Nat Gas	PL
	4	Jun 94/Jun 94	100.0	82.5	CT	Nat Gas	PL
Alabama Power Co							
James H Miller Jr (Jefferson)	4	Mar 91/Jun 81	705.5	667.0	ST	BIT	CO
Alaska							
Cordova Electric Coop Inc							
Humpback Creek (Valdez-Cordova)	1	Jun 90/Jan 88	.5	.5	HC	Water	CO
	2	Jun 90/Jan 88	.5	.5	HC	Water	CO
	3	Jun 90/Jan 88	.3	.2	HC	Water	CO
Pelican Utility Co							
Pelican (UNKNOWN)	IC5	Jun 90/Jun 90	.4	.4	IC	FO2	CO
Arizona							
Arizona Public Service Co							
Gila Bend (Maricopa)	GT1	Jun 97/May 92	75.0	61.7	GT	Nat Gas	PL
	GT2	Jun 97/Jun 97	75.0	61.7	GT	Nat Gas	PL
	GT3	Jun 99/Jun 99	75.0	61.7	GT	Nat Gas	PL
	GT4	Jun 99/Jun 99	75.0	61.7	GT	Nat Gas	PL
Bureau of Reclamation							
Waddell (Maricopa)	PS1	May 94/May 91	150.0	153.4	HR	Water	PL
Century Power Corp							
Springerville (Apache)	**0002	Mar 90/Jun 87	397.0	360.0	ST	SUB	CO
	3	Jun 95/Jun 90	397.0	360.0	ST	SUB	CO
Colorado River Indian Irr Proj							
Headgate Rock (UNKNOWN)	1	91/ 91	6.2	6.3	HC	Water	PL
	2	91/ 91	6.2	6.3	HC	Water	PL
	3	91/ 91	6.2	6.3	HC	Water	PL
Arkansas							
Arkansas Electric Coop Corp							
NA 1 (Conway)	1	May 93/May 93	10.8	11.2	HC	Water	PL
	2	Jun 93/Jun 93	10.8	11.2	HC	Water	PL
	3	Jul 93/Jul 93	10.8	11.2	HC	Water	PL
NA 2 (UNKNOWN)	1	Jun 99/Jun 99	100.0	82.5	CT	Nat Gas	PL
California							
California Dept-Wtr Resources							
Devil Canyon (San Bernardino)	3	Dec 91/Sep 91	78.4	87.8	HC	Water	CO
	4	Dec 91/Dec 91	78.4	87.8	HC	Water	CO
Mohave Siphon Power (San Bernardino)	1	Feb 94/Oct 93	10.8	11.2	HC	Water	PL
	2	May 94/Feb 94	10.8	11.2	HC	Water	PL
	3	Aug 94/Jun 94	10.8	11.2	HC	Water	PL
Los Angeles City of							
Harbor Gen Station (Los Angeles)	10	Jan 95/Jan 95	240.0	191.1	CW	WH	PL
Metropolitan Water District							
Etiwanda (San Bernardino)	1	Jul 93/Jun 86	26.5	28.5	HL	Water	PL
Pacific Gas & Electric Co							
PVUSA 2 (Yolo)	1	Jan 92/Jan 90	1.0	1.0	SP	Sun	PL
PVUSA 3 (San Luis Obispo)	1	Jan 92/Jan 91	1.0	1.0	SP	Sun	PL
Salt Springs Unit 1 (Amador)	HY3	Jun 94/Jan 87	6.0	6.1	HC	Water	PL

Table 21. Projected Electric Generating Unit Additions, by State, Company, and Plant, 1990-1999, as of December 31, 1989 (Continued)

State Company Plant (County)	Unit ID	Scheduled Completion Date Current/Original	Generator Nameplate Capacity	Summer Capability (megawatts)	Unit Type[1]	Energy Source[1]	Unit Status
California							
Pacific Gas & Electric Co							
Unid PG&E Hydro 94 (UNKNOWN)	1	Jan 94/Jan 90	20.1	21.4	HC	Water	PL
Unid PG&E Hydro 96 (UNKNOWN)	NA1	Jan 96/Jan 91	2.1	2.1	HC	Water	PL
Unid PG&E Hydro 97 (UNKNOWN)	NA1	Jan 97/Jan 92	2.3	2.3	HC	Water	PL
West Point (Amador)	2	Mar 91/Jan 87	7.0	7.2	HC	Water	PL
Wise 2 (Placer)	NA1	Jan 98/Jan 95	3.0	3.0	HC	Water	PL
Redding City of							
Lake Red Bluff (Tehama)	1	Jul 99/Jul 99	4.0	4.0	HC	Water	PL
	2	Jul 99/Jul 99	4.0	4.0	HC	Water	PL
Lake Redding (Shasta)	1	Jul 98/Jul 98	5.0	5.1	HC	Water	PL
	2	Jul 98/Jul 98	5.0	5.1	HC	Water	PL
	3	Jul 98/Jul 98	5.0	5.1	HC	Water	PL
Spring Creek (Shasta)	1	May 95/May 95	50.0	50.8	HR	Water	PL
	2	May 95/May 95	25.0	25.3	HR	Water	PL
	3	May 95/May 95	25.0	25.3	HR	Water	PL
Colorado							
Colorado Springs City of							
Nixon (UNKNOWN)	1	Apr 99/Apr 99	75.0	61.7	GT	Nat Gas	PL
Stanley Canyon (UNKNOWN)	1	Sep 94/Sep 94	90.0	91.7	HR	Water	PL
Delaware							
Delmarva Power & Light Co							
Hay Road (New Castle)	3	May 93/May 93	100.0	82.5	CT	Nat Gas	PL
	4	May 94/May 94	150.0	121.7	CW	WH	PL
Florida							
Florida Power & Light Co							
Martin (Martin)	1GT1	Dec 93/Dec 93	148.6	120.7	CT	Nat Gas	PL
	1GT2	Dec 93/Dec 93	148.6	120.7	CT	Nat Gas	PL
	1ST1	Dec 93/Dec 93	155.0	125.6	CW	WH	PL
	2GT1	Dec 94/Dec 94	148.6	120.7	CT	Nat Gas	PL
	2GT2	Dec 94/Dec 94	148.6	120.7	CT	Nat Gas	PL
	2ST1	Dec 94/Dec 94	155.0	125.6	CW	WH	PL
	3GT1	Dec 95/Dec 95	148.6	120.7	CT	SNG	PL
	3GT2	Dec 95/Dec 95	148.6	120.7	CT	SNG	PL
	3GT3	Dec 95/Dec 95	148.6	120.7	CT	SNG	PL
	3GT4	Dec 95/Dec 95	148.6	120.7	CT	SNG	PL
	3ST1	Dec 95/Dec 95	153.9	124.8	CW	WH	PL
	3ST2	Dec 95/Dec 98	153.9	124.8	CW	WH	PL
Florida Power Corp							
Debary (Volusia)	10	Nov 92/Nov 92	84.0	68.9	GT	FO2	PL
	7	Nov 92/Nov 92	84.0	68.9	GT	FO2	PL
	8	Nov 92/Nov 92	84.0	68.9	GT	FO2	PL
	9	Nov 92/Nov 92	84.0	68.9	GT	FO2	PL
Intercession City (Osceola)	10	Nov 93/Nov 93	84.0	68.9	GT	FO2	PL
	7	Nov 93/Nov 93	84.0	68.9	GT	FO2	PL
	8	Nov 93/Nov 93	84.0	68.9	GT	FO2	PL
	9	Nov 93/Nov 93	84.0	68.9	GT	FO2	PL
NA 1 (UNKNOWN)	1	Nov 96/Nov 96	144.0	116.8	GT	FO2	PL
	2	Nov 96/Nov 96	144.0	116.8	GT	FO2	PL
	3	Nov 96/Nov 96	144.0	116.8	GT	FO2	PL
NA 2 (UNKNOWN)	1	Nov 97/Nov 97	216.4	173.1	CT	Nat Gas	PL
	3	Nov 99/Nov 99	216.4	173.1	CT	Nat Gas	PL
Gainesville Regional Utilities							
Deerhaven (Alachua)	NA1	Jun 98/Jun 98	35.0	29.3	GT	Nat Gas	PL
	NA2	Jun 99/Jun 99	35.0	29.3	GT	Nat Gas	PL
Gulf Power Co							
Caryville (Jackson)	1	May 94/May 95	126.0	102.4	GT	Nat Gas	PL
	2	May 97/May 97	126.0	102.4	GT	Nat Gas	PL

Table 21. Projected Electric Generating Unit Additions, by State, Company, and Plant, 1990-1999, as of December 31, 1989 (Continued)

State Company Plant (County)	Unit ID	Scheduled Completion Date Current/Original	Generator Nameplate Capacity	Summer Capability (megawatts)	Unit Type[1]	Energy Source[1]	Unit Status
Florida							
Homestead City of							
G W Ivey (Dade)	22	Jan 91/Jan 91	6.5	6.0	IC	Nat Gas	PL
Key West City of							
Stock Island D 1 (Monroe)	NA1	Jan 91/Feb 90	9.8	9.2	IC	FO2	CO
Stock Island D 2 (Monroe)	NA2	Jan 91/Feb 90	9.8	9.2	IC	FO2	CO
Kissimmee Utility Authority							
NA 1 (UNKNOWN)	1	Jan 93/Jan 93	37.0	30.9	GT	Nat Gas	PL
	2	Jan 97/Jan 97	20.0	20.0	ST	BIT	PL
Lakeland City of							
NA 1 (Polk)	1	Jan 94/Jan 98	50.0	41.5	GT	Nat Gas	PL
NA 2 (Polk)	1	Jan 98/Jan 98	50.0	41.5	GT	Nat Gas	PL
Orlando Utilities Comm							
Indian River (Brevard)	C	Jun 93/Jun 93	75.0	61.7	GT	Nat Gas	PL
	D	Jul 93/Jul 93	75.0	61.7	GT	Nat Gas	PL
Stanton Energy (Orange)	2	Jun 96/Jun 96	464.6	438.0	ST	BIT	PL
Tampa Electric Co							
CT (UNKNOWN)	1	Jan 96/Jan 96	79.8	66.5	CT	FO2	PL
	2	Jan 97/Jan 97	79.8	66.5	CT	FO2	PL
	3	Jan 99/Jan 99	80.5	66.1	GT	FO2	PL
	4	Jan 98/Jan 98	71.0	59.4	CW	WH	PL
Georgia							
Oglethorpe Power Corp							
Rocky Mountain (Floyd)	1	Dec 95/Jun 78	282.6	290.1	HR	Water	PL
	2	May 95/Jun 78	282.6	290.1	HR	Water	PL
	3	May 95/Jun 78	282.6	290.1	HR	Water	PL
USCE-Savannah District							
Richard Russell (Elbert)	5	Mar 91/Feb 86	75.0	76.4	HR	Water	CO
	6	Jun 91/May 86	75.0	76.4	HR	Water	CO
	7	Sep 91/Aug 86	75.0	76.4	HR	Water	CO
	8	Dec 91/Nov 86	75.0	76.4	HR	Water	CO
Idaho							
Fall River Rural Elec Coop Inc							
Island Park (Fremont)	HY1	Dec 92/Dec 88	4.8	4.8	HC	Water	PL
Idaho Power Co							
Milner (Cassia)	1	Oct 92/Oct 92	46.6	51.1	HC	Water	PL
	2	Oct 92/Oct 92	12.1	12.6	HC	Water	PL
	3	Oct 92/Oct 92	.7	.7	HC	Water	PL
Swan Falls (Ada)	P1	Feb 93/Jan 87	12.5	13.1	HC	Water	PL
	P2	Mar 93/Jan 87	12.5	13.1	HC	Water	PL
Twin Falls (Twin Falls)	P1	Jan 95/Jan 95	43.5	47.7	HC	Water	PL
Illinois							
Springfield City of							
Lakeside (Sangamon)	GT1	Jun 93/Jun 93	41.4	35.4	CT	SNG	PL
	GT2	Jun 99/Jun 93	41.4	35.4	CT	Nat Gas	PL
Indiana							
Indianapolis Power & Light Co							
NA 1 (UNKNOWN)	1	Apr 96/Apr 96	96.0	78.5	GT	Nat Gas	PL
	2	Apr 96/Apr 96	96.0	78.5	GT	Nat Gas	PL
	3	Apr 97/Apr 97	96.0	78.5	GT	Nat Gas	PL
	4	Apr 98/Apr 98	96.0	78.5	GT	Nat Gas	PL

Table 21. Projected Electric Generating Unit Additions, by State, Company, and Plant, 1990-1999, as of December 31, 1989 (Continued)

State Company Plant (County)	Unit ID	Scheduled Completion Date Current/Original	Generator Nameplate Capacity	Summer Capability (megawatts)	Unit Type[1]	Energy Source[1]	Unit Status
Indiana							
Public Service Co of IN Inc							
NA 1 (UNKNOWN)	1	Apr 95/Apr 95	130.0	105.6	GT	Nat Gas	PL
	2	Apr 95/Apr 95	130.0	105.6	GT	Nat Gas	PL
	3	Apr 95/Apr 95	130.0	105.6	GT	Nat Gas	PL
	4	Apr 97/Apr 97	130.0	105.6	GT	Nat Gas	PL
	5	Apr 99/Apr 99	130.0	105.6	GT	Nat Gas	PL
Southern Indiana Gas & Elec Co							
A B Brown (Posey)	4	Jun 91/Apr 91	88.2	72.3	GT	Nat Gas	CO
Iowa							
Graettinger City of							
Graettinger (Palo Alto)	5	May 90/May 90	1.1	1.0	IC	FO2	CO
Interstate Power Co							
Mason City (Cerro Gordo)	1	Jun 91/Jan 91	30.0	25.2	GT	FO2	CO
	2	Jun 91/Jan 91	30.0	25.2	GT	FO2	CO
Iowa Electric Light & Power Co							
Anamosa (Jones)	HC1	Apr 90/Sep 89	.3	.2	HC	Water	CO
Iowa Power Inc							
Pleasant Hill (Polk)	1	Jun 90/May 90	41.4	34.5	GT	FO2	CO
	2	Jun 90/May 90	41.4	34.5	GT	FO2	CO
Iowa Southern Utilities Co							
Grinnell (Poweshiek)	1	Aug 90/Sep 89	22.3	18.8	GT	Nat Gas	CO
	2	Aug 90/Sep 89	22.3	18.8	GT	Nat Gas	CO
NA 1 (UNKNOWN)	1	May 93/May 93	50.0	41.5	GT	Nat Gas	PL
	2	May 97/May 97	50.0	41.5	GT	Nat Gas	PL
Kansas							
Kingman City of							
Kingman (Kingman)	9	Jun 91/May 90	6.0	5.6	IC	FO2	PL
Mulvane City of							
Mulvane (Sedgwick)	7	Jan 91/Jan 90	.6	.5	IC	FO2	CO
	8	Jan 91/Jan 90	.6	.5	IC	FO2	CO
Russell City of							
Russell (Russell)	11	Dec 90/Jan 90	3.6	3.4	IC	Nat Gas	CO
	12	Dec 90/Jan 90	3.6	3.4	IC	Nat Gas	CO
Sabetha City of							
Sabetha (Nemaha)	IC10	Jun 90/Jun 90	2.5	2.3	IC	FO2	CO
Wamego City of							
Wamego (Pottawatomie)	NA1	Jun 94/Jun 91	2.4	2.2	IC	Nat Gas	PL
Kentucky							
Kentucky Utilities Co							
NA 1 (UNKNOWN)	1	Apr 93/Apr 93	156.0	126.3	GT	Nat Gas	PL
	2	Apr 95/Apr 95	156.0	126.3	GT	Nat Gas	PL
	3	Apr 96/Apr 96	156.0	126.3	GT	Nat Gas	PL
	4	Apr 98/Apr 98	156.0	126.3	GT	Nat Gas	PL
	5	Apr 99/Apr 99	156.0	126.3	GT	Nat Gas	PL
Louisville Gas & Electric Co							
Cane Run (Jefferson)	12	Jul 97/Jul 97	75.0	61.7	GT	FO2	PL
Trimble County (Trimble)	1	Oct 90/Aug 81	566.1	480.0	ST	BIT	CO
Vanceburg City of							
Meldahl Gen Station (Bracken)	1	Sep 92/Jun 89	23.4	25.1	HC	Water	PL

Table 21. Projected Electric Generating Unit Additions, by State, Company, and Plant, 1990-1999, as of December 31, 1989 (Continued)

State Company Plant (County)	Unit ID	Scheduled Completion Date Current/Original	Generator Nameplate Capacity	Summer Capability (megawatts)	Unit Type[1]	Energy Source[1]	Unit Status
Kentucky							
Vanceburg City of							
	2	Sep 92/Jun 89	23.4	25.1	HC	Water	PL
	3	Sep 92/Jun 89	23.4	25.1	HC	Water	PL
Maine							
Bangor Hydro-Electric Co							
Basin Mills (Penobscot)	1	Apr 99/Nov 91	12.0	12.5	HC	Water	PL
	2	Apr 99/Jan 97	12.0	12.5	HC	Water	PL
	3	Apr 99/Apr 99	12.0	12.5	HC	Water	PL
Milford (Penobscot)	7	Jan 93/Jan 93	1.2	1.1	HC	Water	PL
Veazie C (Penobscot)	1	Apr 96/Nov 90	8.0	8.2	HC	Water	PL
Central Maine Power Co							
Charles E Monty (Androscoggin)	NA1	Sep 90/Apr 87	12.5	13.1	HC	Water	CO
	NA2	Sep 90/Apr 87	12.5	13.1	HC	Water	CO
Maryland							
Baltimore Gas & Electric Co							
Brandon Shores (Anne Arundel)	2	Jun 91/Apr 85	685.1	640.0	ST	BIT	CO
Perryman (Harford)	51	Jun 95/Jun 96	170.0	137.3	GT	Nat Gas	PL
	52	Jun 96/Jun 97	170.0	137.3	GT	Nat Gas	PL
	61	Jun 97/Jun 97	170.0	137.3	GT	Nat Gas	PL
	62	Jun 98/Jun 98	170.0	137.3	GT	Nat Gas	PL
Delmarva Power & Light Co							
Nanticoke (Dorchester)	ST1	May 99/May 87	150.0	150.0	ST	BIT	PL
Easton Utilities Comm							
Easton 2 (Talbot)	24	May 93/Dec 91	6.3	5.9	IC	FO6	PL
	24A	May 93/Dec 91	6.3	5.9	IC	FO6	PL
	25	May 96/Dec 95	15.0	14.1	IC	FO6	PL
	28	May 99/May 99	20.0	18.8	IC	FO6	PL
Potomac Electric Power Co							
Chalk Point (Prince Georges)	GT3	Jun 91/Jun 91	84.0	68.9	GT	Nat Gas	PL
	GT4	Jun 91/Jun 91	84.0	68.9	GT	Nat Gas	PL
	GT5	Jun 91/ 90	104.0	84.9	GT	FO2	PL
	GT6	Jun 91/Jun 91	104.0	84.9	GT	FO2	PL
Coal Gas CC 1 (Montgomery)	CT1	92/ 94	127.0	103.8	CT	FO2	PL
	CT2	93/ 95	127.0	103.8	CT	FO2	PL
Coal Gas CC 2 (Montgomery)	CT3	96/ 96	127.0	103.8	CT	FO2	PL
	CT4	98/ 97	127.0	103.8	CT	FO2	PL
SMECO CT (Prince Georges)	**1	Jun 90/Jun 90	84.0	68.9	GT	FO2	CO
Massachusetts							
Peabody City of							
Waters River (Essex)	2	Dec 90/Dec 90	36.4	30.4	GT	Nat Gas	PL
Minnesota							
Northern States Power Co							
Future Base (UNKNOWN)	1	May 98/May 98	400.0	400.0	ST	Coal	PL
NA 1 (UNKNOWN)	1	May 94/May 94	100.0	81.7	GT	Nat Gas	PL
	2	May 97/May 97	100.0	81.7	GT	Nat Gas	PL
Mississippi							
South Mississippi El Pwr Assn							
Moselle (Jones)	4	Jun 93/Jun 93	80.0	66.6	CT	Nat Gas	PL
	5	Jun 94/Jun 94	40.0	34.3	CW	WH	PL
	6	Jun 97/Jun 97	80.0	66.6	CT	Nat Gas	PL
	7	Jun 98/Jun 98	40.0	34.3	CW	WH	PL

Table 21. Projected Electric Generating Unit Additions, by State, Company, and Plant, 1990-1999, as of December 31, 1989 (Continued)

State Company Plant (County)	Unit ID	Scheduled Completion Date Current/Original	Generator Nameplate Capacity	Summer Capability (megawatts)	Unit Type[1]	Energy Source[1]	Unit Status
Missouri							
Empire District Electric Co							
Empire Energy Center (Jasper)	NA2	Jun 96/Jun 95	32.0	26.8	GT	Nat Gas	PL
	NA3	Jun 99/Jun 95	32.0	26.8	GT	Nat Gas	PL
	3	Jun 95/Jun 92	75.0	62.6	CA	Nat Gas	PL
	4	Jun 97/Jun 97	75.0	62.6	CA	Nat Gas	PL
Kansas City Power & Light Co							
Combustion Turbine 1 (Jackson)	NA4	Jun 96/Jun 96	105.0	85.7	GT	Nat Gas	PL
	NA5	Jun 97/Jun 97	105.0	85.7	GT	Nat Gas	PL
	NA6	Jun 97/Jun 97	105.0	85.7	GT	Nat Gas	PL
	NA7	Jun 99/Jun 99	105.0	85.7	GT	Nat Gas	PL
	1	Jun 94/Mar 96	105.0	85.7	GT	Nat Gas	PL
Combustion Turbine 2 (Jackson)	2	Jun 95/Mar 96	105.0	85.7	GT	Nat Gas	PL
Combustion Turbine 3 (Jackson)	3	Mar 96/Mar 98	105.0	85.7	GT	Nat Gas	PL
Iatan (Platte)	2	Mar 99/May 85	725.8	500.0	ST	SUB	PL
Springfield City of							
James River (Greene)	GT2	May 92/May 93	71.4	58.8	GT	Nat Gas	PL
NA 1 (UNKNOWN)	1	Jun 97/Jun 97	50.0	50.0	ST	Coal	PL
St Joseph Light & Power Co							
Lake Road (Buchanan)	7	May 90/May 90	18.6	15.8	JE	FO2	CO
	8	May 95/May 95	75.0	61.7	GT	Nat Gas	PL
Union Electric Co							
NA 1 (UNKNOWN)	1	May 97/May 97	75.0	61.7	GT	FO2	PL
	2	May 98/May 98	75.0	61.7	GT	FO2	PL
	3	May 99/May 99	75.0	61.7	GT	FO2	PL
UtiliCorp United Inc							
RG 1 & 2 (Cass)	1	Jun 92/Jun 85	22.0	18.6	GT	Nat Gas	PL
	2	Jun 96/Jun 85	22.0	18.6	GT	Nat Gas	PL
Nebraska							
Omaha Public Power District							
NA 1 (UNKNOWN)	NA1	May 95/ 96	106.0	86.5	GT	Nat Gas	PL
	NA2	May 99/May 99	106.0	86.5	GT	Nat Gas	PL
Nevada							
Nevada Power Co							
Clark (Clark)	10	Jun 94/Jun 91	90.0	74.6	CW	WH	PL
	9	Jun 93/Jun 90	90.0	74.6	CW	WH	PL
Harry Allen (Clark)	GT1	Jun 94/Jun 93	78.0	64.1	GT	FO2	PL
	GT2	Jun 95/Jun 94	78.0	64.1	GT	FO2	PL
	GT3	Jun 96/Jun 96	78.0	64.1	GT	FO2	PL
	GT4	Jun 96/Jun 96	78.0	64.1	GT	FO2	PL
	**1	Jun 97/Jun 95	250.0	250.0	ST	BIT	PL
	**2	Jun 98/Jun 98	250.0	250.0	ST	BIT	PL
	**3	Jun 99/Jun 99	250.0	250.0	ST	BIT	PL
White Pine Station (White Pine)	**1	Jun 94/Jun 89	812.0	750.0	ST	BIT	PL
	**2	Jun 95/Jun 90	812.0	750.0	ST	BIT	PL
New Hampshire							
Public Service Co of NH							
Seabrook (Rockingham)	**1	Jan 90/Nov 79	1,200.0	1,150.0	NP	Uranium	LP
New Jersey							
Jersey Central Power&Light Co							
NA 1 (UNKNOWN)	1	Jun 94/Jun 94	100.0	81.7	GT	FO2	PL
NA 2 (UNKNOWN)	1	Jun 95/Jun 96	200.0	161.0	GT	Nat Gas	PL
NA 3 (UNKNOWN)	1	Jun 97/Jun 95	200.0	160.4	CT	Nat Gas	PL
	2	Jun 97/Jun 96	100.0	82.5	CA	Nat Gas	PL
NA 4 (UNKNOWN)	1	Jun 98/Jun 97	300.0	239.4	GT	Nat Gas	PL
NA 5 (UNKNOWN)	1	May 96/May 96	200.0	160.4	CT	Nat Gas	PL
	2	May 96/May 96	100.0	82.5	CA	Nat Gas	PL

Table 21. Projected Electric Generating Unit Additions, by State, Company, and Plant, 1990-1999, as of December 31, 1989 (Continued)

State Company Plant (County)	Unit ID	Scheduled Completion Date Current/Original	Generator Nameplate Capacity	Summer Capability (megawatts)	Unit Type[1]	Energy Source[1]	Unit Status
New Jersey							
Jersey Central Power&Light Co							
NA 6 (UNKNOWN)	1	May 99/May 99	200.0	160.4	CT	Nat Gas	PL
	2	May 99/May 99	100.0	82.5	CA	Nat Gas	PL
Vineland City of							
Butler (Cumberland)	1	Jun 94/Jun 93	35.0	30.1	CT	Nat Gas	PL
	3	Jun 94/Jun 94	16.0	14.2	CW	WH	PL
	4	Jun 94/Jun 94	50.0	42.4	CT	Nat Gas	PL
New York							
Niagara Mohawk Power Corp							
High Dam (Oswego)	5	Dec 94/Nov 88	2.5	2.5	HC	Water	PL
Hudson Falls (Saratoga)	A	Dec 94/Nov 85	36.1	39.3	HC	Water	PL
Mechanicville (Saratoga)	N1	Dec 94/May 84	12.0	12.5	HC	Water	PL
Minetto (Oswego)	N1	Jan 98/Nov 89	1.8	1.8	HC	Water	PL
Oswego Falls West (Oswego)	6	Dec 94/Nov 87	1.9	1.8	HC	Water	PL
	7	Dec 94/Nov 87	1.9	1.8	HC	Water	PL
	8	Dec 94/Nov 87	1.9	1.8	HC	Water	PL
South Glens Falls (Saratoga)	N1	Dec 94/Nov 89	13.8	14.5	HC	Water	PL
Varick (Oswego)	1	Jan 98/Nov 90	4.6	4.6	HC	Water	PL
Yaleville (St Lawrence)	3	Dec 94/Sep 93	1.0	1.0	HC	Water	PL
Power Authority of State of NY							
Crescent (Albany)	NA1	Jun 90/Jan 86	3.0	3.0	HC	Water	CO
	NA2	Jun 90/Jan 86	3.0	3.0	HC	Water	CO
Lewiston (Niagara)	13	Sep 96/Jul 90	30.0	30.4	HR	Water	PL
	14	Nov 96/Jul 90	30.0	30.4	HR	Water	PL
Vischer Ferry (Saratoga)	NA1	Oct 90/Apr 86	3.0	3.0	HC	Water	CO
	NA2	Oct 90/Apr 86	3.0	3.0	HC	Water	CO
North Dakota							
Northern States Power Co							
Dakotas (UNKNOWN)	1	May 96/May 96	460.0	423.0	ST	LIG	PL
Ohio							
Cincinnati Gas & Electric Co							
W H Zimmer (Clermont)	**ST1	Apr 91/Jun 91	1300.0	1286.0	ST	BIT	CO
Woodsdale (Butler)	GT1	Apr 92/Apr 92	75.0	61.7	GT	Nat Gas	PL
	GT10	Apr 96/Apr 96	75.0	61.7	GT	Nat Gas	PL
	GT11	Apr 96/Apr 96	75.0	61.7	GT	Nat Gas	PL
	GT12	Apr 96/Apr 96	75.0	61.7	GT	Nat Gas	PL
	GT2	Apr 92/Apr 92	75.0	61.7	GT	Nat Gas	PL
	GT3	Apr 92/Apr 92	75.0	61.7	GT	Nat Gas	PL
	GT4	Apr 92/Apr 92	75.0	61.7	GT	Nat Gas	PL
	GT5	Apr 92/Apr 92	75.0	61.7	GT	Nat Gas	PL
	GT6	Apr 93/Apr 93	75.0	61.7	GT	Nat Gas	PL
	GT7	Apr 94/Apr 94	75.0	61.7	GT	Nat Gas	PL
	GT8	Apr 96/Apr 96	75.0	61.7	GT	Nat Gas	PL
	GT9	Apr 96/Apr 96	75.0	61.7	GT	Nat Gas	PL
Dover City of							
Dover (Tuscarawas)	6	Aug 90/Jun 89	18.0	15.3	GT	Nat Gas	CO
	7	Oct 92/Jun 91	20.0	20.0	ST	BIT	PL
Painesville City of							
Painesville (Lake)	7	Jan 90/Aug 89	22.0	24.2	ST	BIT	CO
Oklahoma							
Oklahoma Gas & Electric Co							
Conoco (Kay)	1	Nov 90/Nov 90	26.0	21.9	GT	Nat Gas	CO
	2	Nov 90/Nov 90	26.0	21.9	GT	Nat Gas	CO
NA 1 (UNKNOWN)	1	May 98/May 89	100.0	81.7	GT	Nat Gas	PL
	2	May 99/May 90	170.0	137.3	GT	Nat Gas	PL

Table 21. Projected Electric Generating Unit Additions, by State, Company, and Plant, 1990-1999, as of December 31, 1989 (Continued)

State Company Plant (County)	Unit ID	Scheduled Completion Date Current/Original	Generator Nameplate Capacity	Summer Capability (megawatts)	Unit Type[1]	Energy Source[1]	Unit Status
South Carolina							
Duke Power Co							
Bad Creek (Oconee)	1	Apr 92/Apr 91	266.3	273.3	HR	Water	CO
	2	Apr 92/Apr 91	266.3	273.3	HR	Water	CO
	3	Jan 93/Apr 92	266.3	273.3	HR	Water	CO
	4	Apr 92/Apr 92	266.3	273.3	HR	Water	CO
South Carolina Electric&Gas Co							
Hagood (Charleston)	4	May 91/May 91	121.8	99.1	GT	Nat Gas	PL
NA 1 (UNKNOWN)	GT1	May 93/May 93	96.0	78.5	GT	Nat Gas	PL
NA 2 (UNKNOWN)	GT2	May 94/May 94	96.0	78.5	GT	Nat Gas	PL
NA 3 (UNKNOWN)	GT3	May 94/May 94	96.0	78.5	GT	Nat Gas	PL
NA 4 (UNKNOWN)	ST1	May 97/May 97	350.0	350.0	ST	BIT	PL
South Carolina Pub Serv Auth							
Cross (Berkeley)	1	Dec 95/May 85	556.2	520.0	ST	BIT	CO
Spartanburg City of							
Blalock (Spartanburg)	3	Jan 98/Jan 89	2.5	2.5	HC	Water	PL
South Dakota							
Black Hills Corp							
CT (UNKNOWN)	5	Jul 94/Jul 94	40.0	33.3	GT	Nat Gas	PL
Northwestern Public Service Co							
Huron (Beadle)	2	May 91/May 91	21.2	17.9	GT	Nat Gas	PL
	3	May 99/May 99	22.8	19.2	GT	FO2	PL
Tennessee							
Tennessee Valley Authority							
Watts Bar (Rhea)	1	Oct 91/Oct 76	1269.9	1170.0	NP	Uranium	CO
	2	Oct 95/Apr 77	1269.9	1170.0	NP	Uranium	CO
Texas							
Brazos Electric Power Coop Inc							
NA 1 (UNKNOWN)	1	Jan 98/Jan 98	300.0	236.7	CT	Nat Gas	PL
	2	Jan 98/Jan 98	300.0	236.7	CT	Nat Gas	PL
R W Miller (Palo Pinto)	4	Jan 93/Jan 93	100.0	81.7	GT	Nat Gas	PL
	5	Jan 95/Jan 95	100.0	81.7	GT	Nat Gas	PL
Denton City of							
Lewisville (Denton)	1	Mar 91/ 86	2.8	2.8	HC	Water	CO
Roberts (Denton)	1	Mar 91/ 88	1.0	1.0	HC	Water	CO
El Paso Electric Co							
Generic Stat (UNKNOWN)	1	Jan 96/Jan 96	70.0	57.6	GT	Nat Gas	PL
	2	Jan 98/Jan 98	70.0	57.6	GT	Nat Gas	PL
Houston Lighting & Power Co							
Malakoff (Henderson)	1	Dec 96/Mar 87	726.8	645.0	ST	LIG	PL
	2	Dec 98/Mar 88	726.8	645.0	ST	LIG	PL
Lubbock City of							
LP&L Cogen Plant (Lubbock)	1	May 90/May 90	20.0	16.9	GT	Nat Gas	CO
San Antonio City of							
GT 98 (Bexar)	1	Feb 98/Feb 98	70.0	57.6	GT	Nat Gas	PL
	2	Feb 98/Feb 98	70.0	57.6	GT	Nat Gas	PL
GT 99 (Bexar)	1	Feb 99/May 98	70.0	57.6	GT	Nat Gas	PL
	2	Feb 99/May 98	70.0	57.6	GT	Nat Gas	PL
	3	Feb 99/May 99	70.0	57.6	GT	Nat Gas	PL
J K Spruce (Bexar)	1	May 92/May 92	546.0	498.0	ST	SUB	CO
	2	May 97/May 97	546.0	498.0	ST	SUB	PL

Table 21. Projected Electric Generating Unit Additions, by State, Company, and Plant, 1990-1999, as of December 31, 1989 (Continued)

State Company Plant (County)	Unit ID	Scheduled Completion Date Current/Original	Generator Nameplate Capacity	Summer Capability (megawatts)	Unit Type[1]	Energy Source[1]	Unit Status
Virginia							
Virginia Electric & Power Co							
	2	Nov 90/Nov 90	89.5	73.3	GT	FO2	CO
	3	Nov 90/Nov 90	89.5	73.3	GT	FO2	CO
	4	Nov 90/Nov 90	89.5	73.3	GT	FO2	CO
Washington							
PUD No 1 of Pend Oreille Cnty							
Sullivan Creek (Pend Oreille)	1	Sep 95/Sep 89	8.0	8.2	HC	Water	PL
	2	Sep 95/Sep 89	8.0	8.2	HC	Water	PL
PUD No 2 of Grant County							
PEC Headworks (Grant)	**1	Apr 90/Apr 89	6.7	6.8	HC	Water	CO
Seattle City of							
South Fork Tolt (King)	1	94/Nov 85	15.0	15.8	HC	Water	PL
Tacoma City of							
Wynoochee (Grays Harbor)	1	Jan 92/Jun 91	7.5	7.7	HC	Water	PL
	2	Jan 92/Jun 91	3.3	3.3	HC	Water	PL
Wisconsin							
Madison Gas & Electric Co							
Combustion Turbine (Dane)	1	Jun 95/Jun 95	90.0	73.7	GT	Nat Gas	PL
	2	Jun 99/Jun 98	45.0	37.4	GT	Nat Gas	PL
Manitowoc City of							
Manitowoc (Manitowoc)	8	Dec 98/Dec 98	60.0	60.0	ST	BIT	PL
Marshfield City of							
NA (UNKNOWN)	1	Jun 92/Jun 92	15.0	12.8	GT	Nat Gas	PL
Wisconsin Electric Power Co							
Concord (Jefferson)	1	Jun 93/Jun 93	75.0	61.7	GT	Nat Gas	PL
	2	Jun 93/Jun 93	75.0	61.7	GT	Nat Gas	PL
NA 1 (UNKNOWN)	1	Jun 93/Jun 93	3.0	3.0	HC	Water	PL
NA 2 (UNKNOWN)	1	Jun 94/Jun 94	75.0	61.7	GT	Nat Gas	PL
	2	Jun 94/Jun 94	75.0	61.7	GT	Nat Gas	PL
NA 3 (UNKNOWN)	1	Jun 95/Jun 95	75.0	61.7	GT	Nat Gas	PL
	2	Jun 95/Jun 95	75.0	61.7	GT	Nat Gas	PL
NA 4 (UNKNOWN)	1	Jun 96/Jun 96	75.0	61.7	GT	Nat Gas	PL
	2	Jun 96/Jun 96	75.0	61.7	GT	Nat Gas	PL
NA 5 (UNKNOWN)	1	Jun 97/Jun 97	75.0	61.7	GT	Nat Gas	PL
	2	Jun 97/Jun 97	75.0	61.7	GT	Nat Gas	PL
Wisconsin Power & Light Co							
NA 1 (Fond Du Lac)	CT1	Mar 94/Mar 94	90.0	73.7	GT	Nat Gas	PL
	CT2	Mar 96/Mar 96	90.0	73.7	GT	Nat Gas	PL
	CT3	Mar 96/Mar 96	90.0	73.7	GT	Nat Gas	PL
	CT4	Mar 99/Mar 99	90.0	73.7	GT	Nat Gas	PL
Wisconsin Public Service Corp							
Rainbow (Oneida)	1	Mar 98/Mar 98	1.1	1.1	HC	Water	PL
Trappe (UNKNOWN)	1	Mar 98/Mar 98	4.0	4.0	HC	Water	PL

* Capacity less than 0.05 megawatts.

** A jointly owned unit.

Notes: The following units denoted in this table with unit type, CT, are the entire respective proposed combined cycle units, including the steam generator(s)- Arkansas Electric Cooperative Corporation, NA 2, unit 1 - Florida Power Corporation, NA 2, units 1 and 2 - Brazos Electric Power Cooperative, NA 1, units 1 and 2 - Texas Municipal Power Agency, NA 1, unit 2. Each of the following denoted in this table represents multiple proposed generators- Jersey Central Power and Light Company, NA 2, unit 1, NA 3, unit 1, NA 4, unit 1, NA 5, unit 1, NA 6, unit 1 - Oklahoma Gas and Electric Company, NA 1, unit 2 - Texas Utilities Generating Company, NA 2, unit NA1.

Source: Energy Information Administration, Form EIA-860, "Annual Electric Generator Report."

Table 21. Projected Electric Generating Unit Additions, by State, Company, and Plant, 1990-1999, as of December 31, 1989 (Continued)

State Company Plant (County)	Unit ID	Scheduled Completion Date Current/Original	Generator Nameplate Capacity	Summer Capability (megawatts)	Unit Type[1]	Energy Source[1]	Unit Status
Texas							
San Miguel Electric Coop Inc							
San Miguel (Atascosa)	**2	Jun 97/Jan 89	450.0	400.0	ST	LIG	PL
Texas Municipal Power Agency							
NA 1 (UNKNOWN)	1	Apr 96/Apr 96	120.0	97.7	GT	Nat Gas	PL
	2	Jan 99/Jan 99	118.9	97.4	CT	Nat Gas	PL
Texas Utilities Generating Co							
Comanche Peak (Somervell)	**1	Feb 90/Jan 80	1215.0	1150.0	NP	Uranium	CO
	**2	Dec 91/Jan 82	1215.0	1150.0	NP	Uranium	CO
Forest Grove (Henderson)	1	Jan 98/Dec 78	795.8	750.0	ST	LIG	CO
NA 2 (UNKNOWN)	NA1	Feb 97/Feb 96	375.0	293.2	CT	Nat Gas	PL
Twin Oak (Robertson)	1	Jan 95/Jan 81	800.9	750.0	ST	LIG	CO
	2	Jan 96/May 81	800.9	750.0	ST	LIG	CO
Texas-New Mexico Power Co							
TNP ONE (Robertson)	1	Feb 90/Jun 90	194.0	142.0	ST	LIG	CO
	2	Jun 91/Jun 91	194.0	142.0	ST	LIG	CO
	3	Jun 97/Jun 92	194.0	142.0	ST	LIG	PL
	4	Jun 98/Jun 93	194.0	142.0	ST	LIG	PL
Utah							
Bountiful City City of							
East Canyon Dam (Morgan)	NA1	Jun 91/Jun 87	2.0	2.0	HC	Water	CO
	NA2	Jun 91/Jun 87	.5	.5	HC	Water	CO
Joes Valley Dam (Emery)	NA1	Oct 92/Oct 92	1.3	1.2	HC	Water	PL
	NA2	Oct 92/Oct 89	1.3	1.2	HC	Water	PL
	NA3	Oct 92/Oct 86	1.0	1.0	HC	Water	PL
Pine View Dam (Weber)	NA1	Sep 90/Mar 90	1.8	1.8	HC	Water	CO
Deseret Generation & Tran Coop							
Bonanza (Uintah)	2	Aug 95/Jan 97	400.0	400.0	ST	BIT	PL
Logan City of							
Logan Diesel (Cache)	IC5A	May 90/May 90	1.0	.9	IC	FO2	CO
	IC5B	May 90/May 90	1.0	.9	IC	FO2	CO
Mt Pleasant City of							
Unit 3 (Sanpete)	1	Dec 91/Sep 89	.5	.5	HL	Water	PL
Unit 4 (Sanpete)	1	Dec 91/Sep 88	1.5	1.4	HL	Water	PL
Weber Basin Water Conserv Dist							
West Gateway (Davis)	1	Dec 92/Dec 88	4.0	4.0	HC	Water	PL
Vermont							
Morrisville Village of							
Garfield (Lamoille)	HC1	94/ 94	1.3	1.2	HC	Water	PL
	HC2	94/ 94	1.3	1.2	HC	Water	PL
Swanton Village of							
Highgate Falls (Franklin)	4	Apr 90/Mar 88	4.5	4.5	HC	Water	CO
Virginia							
Culpeper Town of							
Culpeper 2 (Culpeper)	1	Jan 95/Jan 95	2.0	1.8	IC	FO2	PL
	2	Jan 95/Jan 95	2.0	1.8	IC	FO2	PL
Virginia Electric & Power Co							
Chesterfield (Chesterfield)	7	Jun 90/Apr 92	72.0	60.2	CW	WH	CO
	7A	Jun 90/Apr 92	147.0	119.4	CT	Nat Gas	CO
	8A	Jun 92/Jun 92	147.0	119.4	CT	Nat Gas	PL
	8B	Jun 92/Jun 92	72.0	60.2	CW	WH	PL
Clover (Halifax)	**1	Dec 93/Dec 93	393.0	393.0	ST	Coal	PL
	**2	Dec 94/Dec 94	393.0	393.0	ST	Coal	PL
Darbytown (Henrico)	1	Nov 90/Nov 90	89.5	73.3	GT	FO2	CO

APPENDIX B

PROJECTION INVENTORY QUALITY ASSURANCE CHECKLIST

APPENDIX B

PROJECTION INVENTORY QA CHECKLIST

I. General and Background Information

1. What classification is/are the nonattainment area(s) for the following pollutants?
   a. Ozone
      ____ Marginal (.121 to .137 ppm)
      ____ Moderate (.138 to .159 ppm)
      ____ Serious (.160 to .179 ppm)
      ____ Severe 1 (.180 to .190 ppm)
      ____ Severe 2 (.191 to .279 ppm)
      ____ Extreme (.280 + ppm)

   b. Carbon Monoxide
      ____ Moderate (9.1 to 16.4 ppm)
      ____ Serious (16.5 + ppm)

2. What are the projection years? ________

3. What is the projected attainment year? ____

4. What projection models are used?
   Comment: ____________________
   ____

II. Types of Projections

1. Do the Baseline Emission Projections contain consistent emission estimation methods?
   Yes ____ No ____
   Comment: ____________________
   ____

2. What were the sources of the Area Source growth and control data?
   Comment: ____________________
   ____

3. What inconsistencies between control strategies and inventories exist?
   Comment: ____________________
   ____

   a. How were the inconsistencies resolved?
      Comment: ____________________
      ____

4. Were defaults used in the calculation of Rule Effectiveness?
   Yes ____ No ____
   Comment: ____________________
   ____

a. What was the source of data for non-defaults?
Comment: ______________________________
____

5. Do the projected emissions represent Actual or Allowable emissions?
Actual ____ Allowable____
Comment: ______________________________
____

a. If allowable emissions are used, what offset policy is in effect for the area?
Comment: ______________________________
____

III. Projections of Future Activity

1. Are there dominant sources or large VOC facilities in your area?
Yes ____ No ____
Comment: ______________________________
____

a. Are facility-specific growth and control factors available for these sources?
Yes ____ No ____
Comment: ______________________________
____

2. Are Bureau of Economic Analysis (BEA) defaults used to project future activity?
Yes ____ No ____
Comment: ______________________________
____

a. If BEA defaults are not used, what is the source of the data used to project future activity?
Comment: ______________________________
____

3. Are all 57 types of industry defined by the BEA covered in the projection?
Yes ____ No ____
Comment: ______________________________
____

a. What additional industrial activity data were used?
Comment: ______________________________
____

4. For what categories were the following future activity indicators used in the projection?
a. Product Output
Yes ____ No ____
Comment: ______________________________
____

b. Value added
Yes ____ No ____

Comment: ____________________

c. Earnings
Yes ____ No ____
Comment: ____________________

d. Employment
Yes ____ No ____
Comment: ____________________

IV. Measuring the effects of Current and Future Controls for VOC, NO_x, and CO.

A. VOC Clean Air Act Amendment (CAAA) Requirements

1. As required by the CAAA, are the following National Stationary Measures included in the assessment of Volatile Organic Compounds (VOCs)? (These measures apply whether the facilities are located in non-attainment areas or not)

   a. Hazardous Waste Landfills
   Yes ____ No ____
   Comment: ____________________

   b. Municipal Landfills
   Yes ____ No ____
   Comment: ____________________

   c. Consumer/Commercial Solvents (Phase I)
   Yes ____ No ____
   Comment: ____________________

   d. Architectural Coatings
   Yes ____ No ____
   Comment: ____________________

   e. Marine Vessels
   Yes ____ No ____
   Comment: ____________________

2. Are the following included in the assessment of Motor Vehicle Measures as required by the CAAA?

   a. Gasoline RVP Controls (before 1995)
   Yes ____ No ____
   Comment: ____________________

h. Are you within the Ozone Northeast Transport region?

Yes ____ No ____

If yes the following apply:

Are the following included in your assessment of Area-Specific Measures?

(1) enhanced I/M (populations > 100,000)

Yes ____ No ____

Comment: ____________________

(2) RACT for facilities emitting more than 50 tpy

Yes ____ No ____

Comment: ____________________

i. Are you in California?

Yes ____ No ____

If yes:

Are the following included in your assessment of Area-Specific Measures?

(1) Clean vehicles program (start at 150,000 vehicles in 1996, increase to 300,000 in 1999, more stringent standards starting in 2001)

Yes ____ No ____

Comment: ____________________

4. Are Discretionary Measures being applied? If yes, describe.

Yes ____ No ____

Comment: ____________________

5. What are the effects of Title III (toxic) regulations on VOC sources?

Comment: ____________________

B. NO_x CAAA requirements

1. Are there phase I plants in your area?

Yes ____ No ____

Comment: ____________________

2. Are the following accounted for in your assessment of Utility NO_x emissions?

a. Utility-Generation Growth Factor? Comment on type and calculation of growth factors.

Yes ____ No ____

Comment: ____________________

b. **Area-Specific Measures**

(1) stage II controls (moderate and above)

Yes ____ No ____

Comment: ____

____

(2) fleet clean fuels programs (serious and above)

Yes ____ No ____

Comment: ____

____

(3) reformulated gasoline (severe and above)

Yes ____ No ____

Comment: ____

____

3. Are the following included in your assessment of Area-Specific measures?

a. RACT for major non CTG sources (emitting greater then 50 tpy in serious, 25 tpy in severe, and 10 tpy in extreme - before 1995)

Yes ____ No ____

Comment: ____

____

b. All 11 new CTGs (all sources, moderate and above areas)

Yes ____ No ____

Comment: ____

____

c. All old CTGs (including RACT fix-up program)

Yes ____ No ____

Comment: ____

____

d. Effects of enhanced I/M (serious and above)

Yes ____ No ____

Comment: ____

____

e. Basic I/M (moderate areas)

Yes ____ No ____

Comment: ____

____

f. Maximum Achievable Control Technology (MACT)

Yes ____ No ____

Comment: ____

____

g. Have there been voluntary reductions for toxic sources?

Yes ____ No ____

Comment: ____

____

b. Unit-Specific Future Year Capacity Factor? Comment on calculation, or provide an example.
Yes ____ No ____
Comment: ____
____

c. Comment on how the Total Projected Generation demand was calculated.
Comment: ____
____

d. Does Total Generation from existing and announced utilities meet the demand?
Yes ____ No ____
Comment: ____
____

e. What is the difference between generation demand of the area and the generation from existing and announced units?
Comment: ____
____

3. Was the determination of planned or announced utility plants in the area possible?
Yes ____ No ____
Comment: ____
____

a. How were the plants identified?
Comment: ____
____

b. Were capacity factors available for the plants? Comment on how they were computed.
Yes ____ No ____
Comment: ____
____

(1) If no capacity factors were available, was the default capacity factor of .65 used?
Yes ____ No ____
Comment: ____
____

4. Are the following accounted for in your assessment of NO_x?

a. RACT for major NO_x sources for moderate and above ozone non-attainment areas
Yes ____ No ____
Comment: ____
____

b. RACT for all sources emitting more than 100 tpy of NO_x in ozone northeast transport region.
Yes ____ No ____
Comment: ____
____

C. CO CAAA Requirements

1. Are the following accounted for in your assessment of CO?

   a. Basic I\M for Moderate Areas (before 1995)

      Yes ____ No ____

      Comment: ____

      ____

   b. Enhanced I\M for Serious Areas (before 1995)

      Yes ____ No ____

      Comment: ____

      ____

   c. Oxygenated Gasoline for all Non-Attainment Areas (starting in 1995)

      Yes ____ No ____

      Comment: ____

      ____

V. Combining Growth and Control Effects

1. What was the source of the Industrial Growth Rate data?

   Comment: ____

   ____

2. Where were Population Data obtained?

   Comment: ____

   ____

   a. What Source Categories relied upon population statistics for growth calculations?

      Comment: ____

      ____

3. Were Retirement Rates used?

   Yes ____ No ____

   Comment: ____

   ____

   a. If yes, were the Retirement Rate Data default data from table V.1?

      Yes ____ No ____

      Comment: ____

      ____

      (1) If the data were not from table V.1, how were the data developed?

      Comment: ____

      ____

4. How were VMT Data projected?

   Comment: ____

   ____

5. How were the Emission Factor Ratios for new and existing sources computed?

   Comment: ____

   ____

6. Provide an example of the application of the equation in Section V.A. for stationary sources.
   Comment: ____
   ____

7. Are Historical Growth Data for the facilities or industries available?
   Yes ____ No ____
   Comment: ____
   ____

   a. Were Historical Growth Data obtained for comparison with the projected growth factors?
      Yes ____ No ____
      Comment: ____
      ____

8. Were Industry- or Plant-Specific Data compared to U.S. Department of Commerce estimates?
   Yes ____ No ____
   Comment: ____
   ____

   a. Are the discrepancies understood?
      Yes ____ No ____
      Comment: ____
      ____

VI. Ensuring Consistency with other Emission Inventory Activities

1. Are there any other emission inventory projections available for this area? If so name the project.
   Yes ____ No ____
   Comment: ____
   ____

   a. Are you located in the ROMNET modeling area?
      Yes ____ No ____
      Comment: ____
      ____

   c. Are you located in the LMOS modeling area?
      Yes ____ No ____
      Comment: ____
      ____

2. Do the estimates and/or Raw Growth and Retirement Rates compare with the other study? Can differences be explained?
   Yes ____ No ____
   Comment: ____
   ____

VII. Tracking Considerations

1. Are there SIP and I\M corrections for your area?

   Yes ____ No ____

   Comment: ______________________________

   a. What are the corrections?

      Comment: ______________________________

   b. How are the resulting emission reductions accounted for?

      Comment: ______________________________

2. Provide an example calculation of the 1996 progress requirement emission target?

   Comment: ______________________________

3. If applicable (serious and above ozone areas), provide an example calculation of the 1999 emission reduction target.

   Comment: ______________________________

APPENDIX C

HISTORICAL EARNINGS DATA
(Backcasting Data)

APPENDIX C

HISTORICAL EARNINGS DATA

Historical earnings data are potentially useful in making emission projections both through establishing trends, which can be extrapolated into the short-term future, in having the ability to adjust 1990 base year emission estimates to match with air pollution episodes, which may have occurred during 1987, 1988, or 1989 and in updating portions of prior year emission inventories to 1990. To date, BEA has published historical earnings statistics through 1989. BEA reporting for these statistics are by state and 3-digit Standard Industrial Classification (SIC) code. Because 1990 is such an important year for establishing base year emissions, a trend analysis was applied to the historical data to add estimated 1990 values to the data base. The procedure applied to estimate 1990 values is described briefly below.

Estimation of annual income data using trend line analysis is justified on the basis of inflation or trend inertia. It will fail during major shifts in economic conditions not already established in the prior year's values. Thus, even though the BEA historical data covered 21 years, from 1969 to 1989, only the most recent six years (1984 to 1989) of data were used in this analysis. Some of the state/SIC categories contained a "(D)" entry, which indicates that the data were withheld from publication because of small cell size disclosure policies. This (D) entry was translated to a numeric -99 in the revised data files.

In estimating 1990 values, if any data were 0 or -99 (withheld) in the 1986-1989 period, then the 1990 entry was set equal to the 1989 data adjusted for inflation. In cases where there were at least four years of data prior to and including 1989, a log-linear model of the form of equation (1)

$$y = a_0 * e^{(a_1 * t)} \qquad (1)$$

was fit to the data, and a 1990 value calculated using this model was entered into the file.

Finally, the 1986-1990 current dollar entries were converted to 1982 constant dollars using the implicit price deflator for personal consumption expenditures. The values for each year are listed below:

1986	114.3
1987	119.6
1988	124.2
1989	129.9
1990	136.4

Revised data files with the 3-digit SIC code values for each state for 1986 through 1990 are available from EPA through the CHIEF Bulletin Board System. These data are in spreadsheets.

One of the purposes for developing the above data files was to assist states in estimating 1990 emissions given that significant efforts may have been expended previously to compile emission inventories for a year other than 1990. Several ozone and CO nonattainment areas began preparing 1987, 1988, or 1989 inventories as a result of SIP calls in 1988 or 1989. These inventories either have to be updated to 1990 or completely redone to reflect 1990 conditions.

For states that receive EPA approval to perform updates to the 1987/1988/1989 inventories, the BEA data in the spreadsheet files can be used to adjust prior year emission estimates to 1990 for point sources with emissions less than 100 tons per year. This can be done for any given state by matching the source category of interest with the appropriate 3-digit SIC code. Note that BEA earnings data are meant only to capture likely changes in activity levels and that any change in emission rates for a source or a source category from the original base year emission inventory to 1990 has to be accounted for separately. The BEA data may also be used to update area and non-road mobile source emission estimates to 1990 for any source category for which the state/3-digit SIC code is the best surrogate indicator of activity. In other words, if the historical BEA data were used as an indicator of activity in the original inventory for a source category, then the data in the spreadsheet files can be applied to estimate changes in activity between 1987/1988/1989 and 1990.

Users of the constant dollar BEA historical data files are cautioned to only use them to develop growth factors. Because of the conversion to constant dollars, these data will not match those eventually published by BEA for 1990.

Once a 1990 base year inventory has been compiled, there may be a need to adjust that inventory to correspond with the time period of an air pollution episode. For example, areas planning to apply the Urban Airshed Model may be modeling episodes that occurred in 1987, 1988, or 1989. The BEA data may be useful for that purpose as well. Consultation with EPA is advised before BEA data are used for that purpose because annual earnings data may not always be suitable for estimating day specific conditions. In cases where this technique is valid, backcasting 1990 emissions to prior years can be performed by multiplying 1990 emissions for a given source category by the ratio of the episode year historical earnings to 1990 earnings. The historical BEA data in the spreadsheet files can only be used to adjust 1990 emission estimates to a prior episode year for point sources with emissions less than 100 tons per year (small point sources and non-highway vehicle area sources). Episode year emission estimates for large point sources and highway vehicles will have to be made using information specific to the time period being modeled. As with the techniques described above for using historical BEA data to update 1987/1988/1989 inventories to 1990, it is important to match the source category of interest with the appropriate 3-digit SIC code. The earlier mentioned caveat about BEA earnings data only capturing activity level changes applies here as well.

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-450/4-91-019	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Procedures for Preparing Emissions Projections		5. REPORT DATE July 1991
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15. SUPPLEMENTARY NOTES

EPA Project Officer: Keith Baugues

16. ABSTRACT

The purpose of this document is to provide guidance for projecting emissions to future years. It focuses primarily on procedures for projecting how the combination of future emission controls and changes in source activity will influence future air pollution emission rates.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Emissions, Emission Inventories, Ozone (O_3) Projections		

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES 141
	20. SECURITY CLASS *(This page)*	22. PRICE

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